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SEPTEMBER 1983 BRITAIN'S BIGGEST-SELLING HOME COMPUTER MAGAZINE Vol. 3 No. 9

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Reviews:
Sinclair Microdrive
Electron

BBC Sprites

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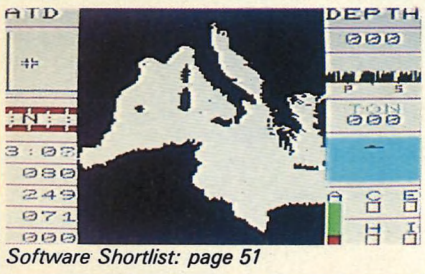

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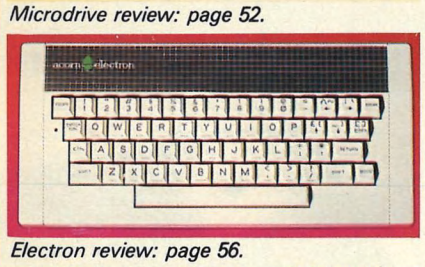
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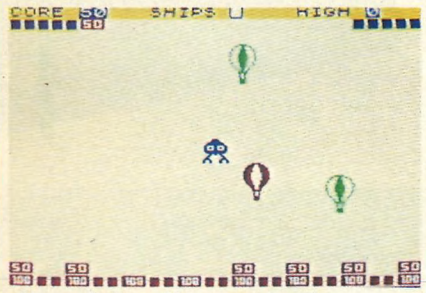

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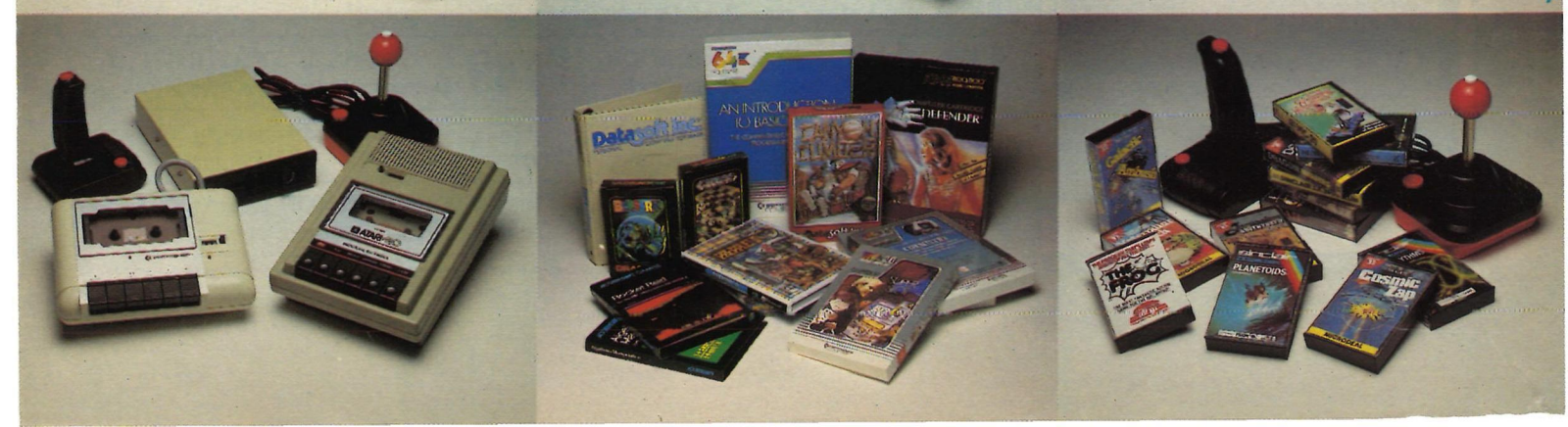

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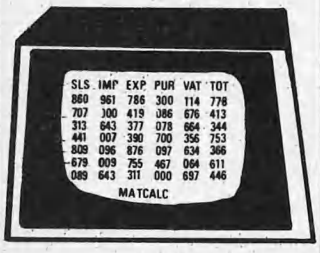

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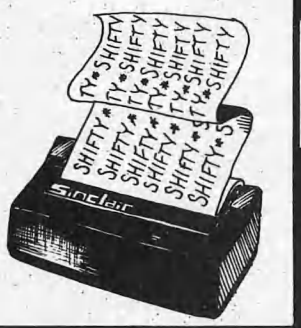

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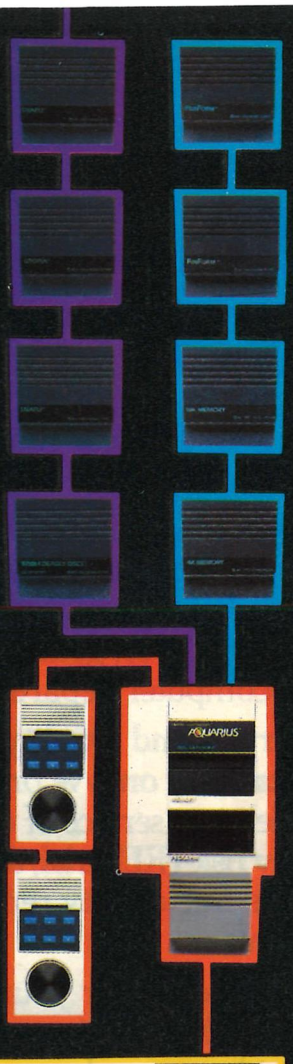

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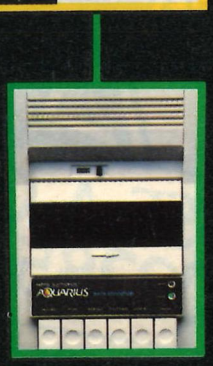

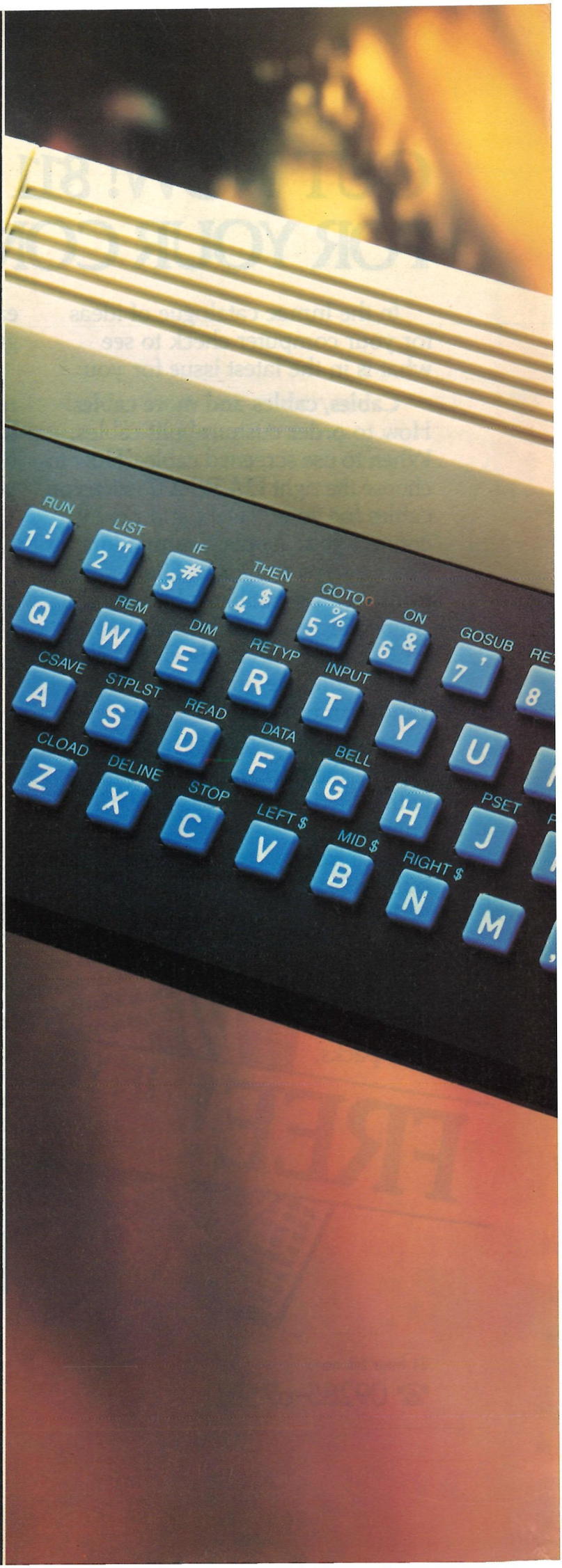

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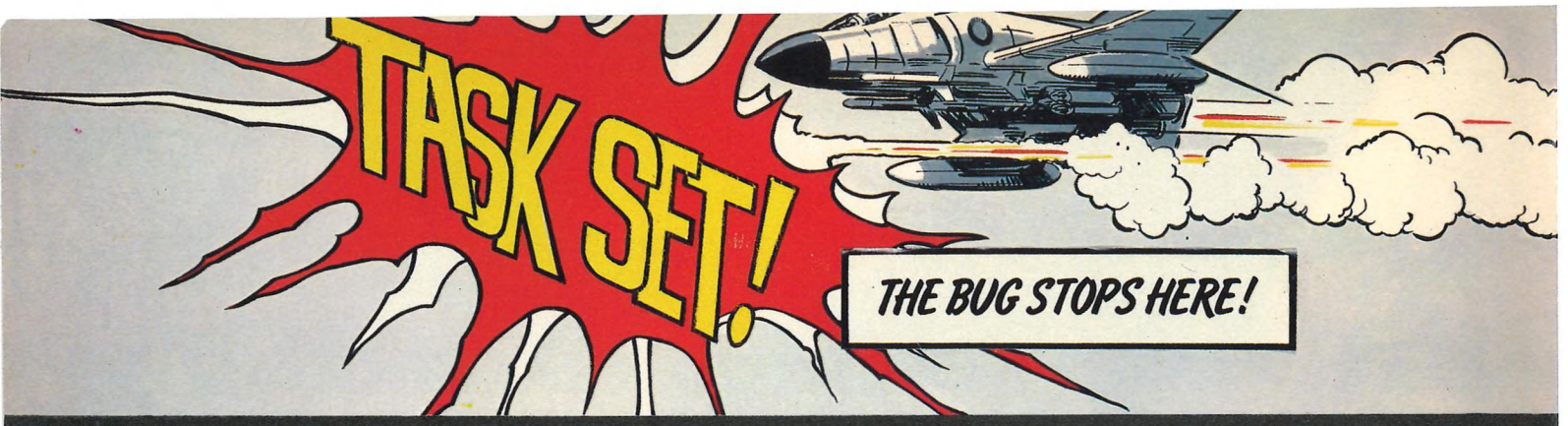

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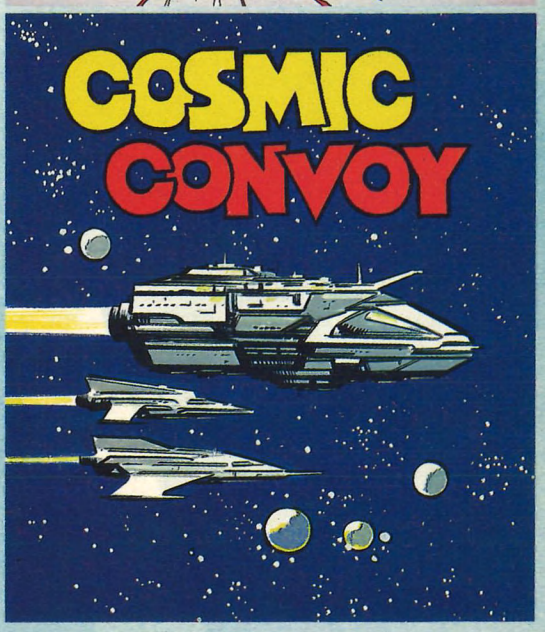

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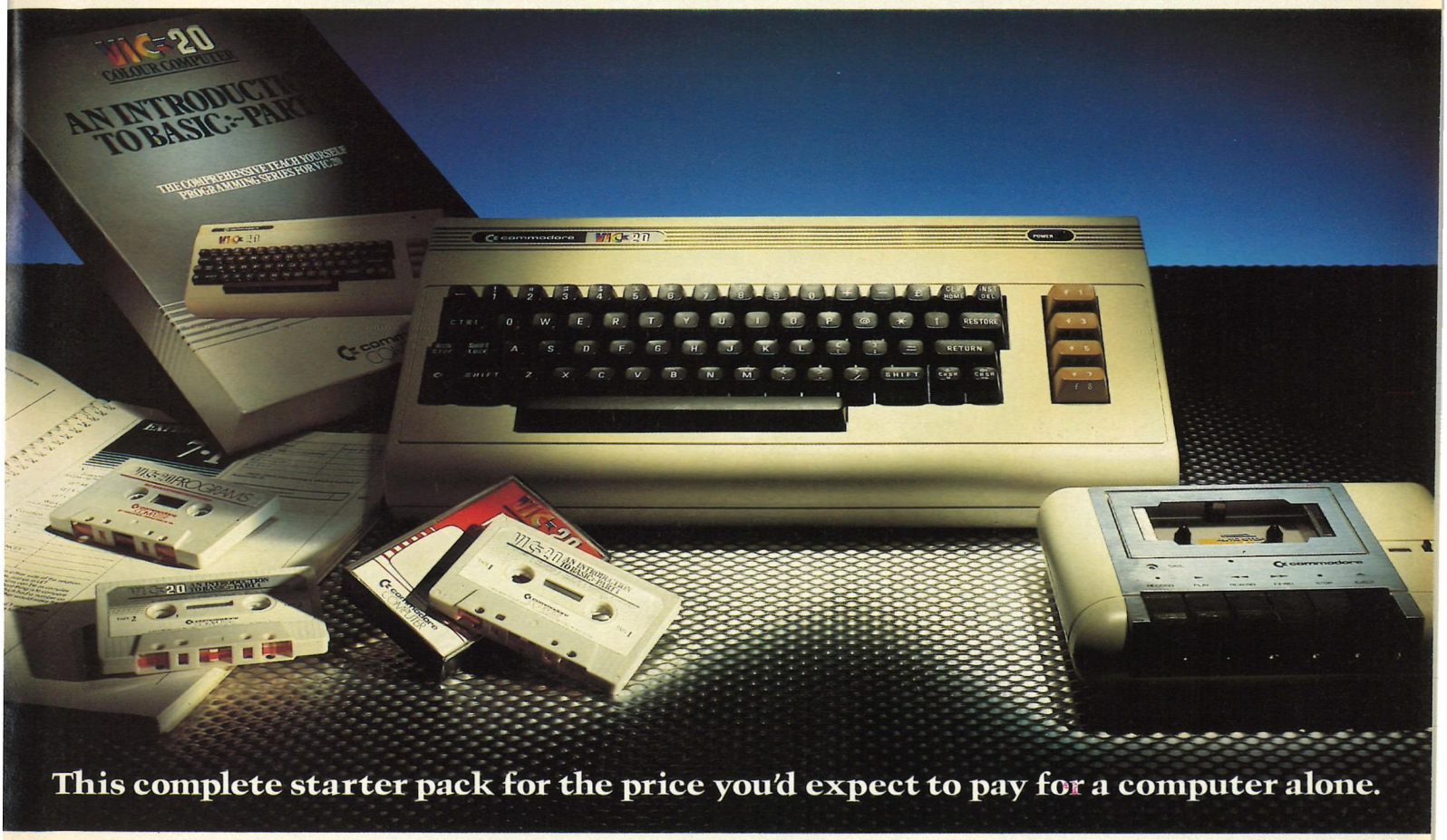

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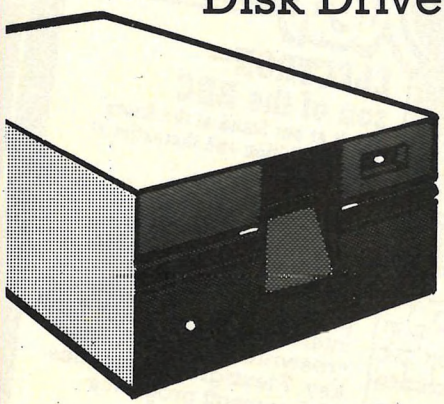

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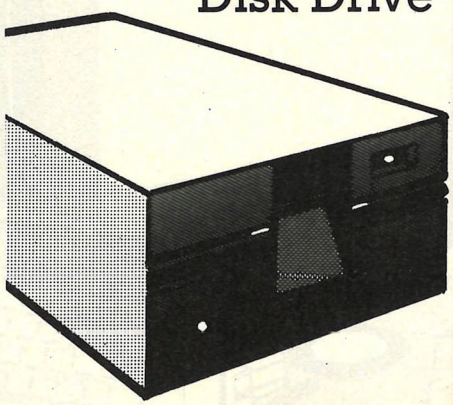

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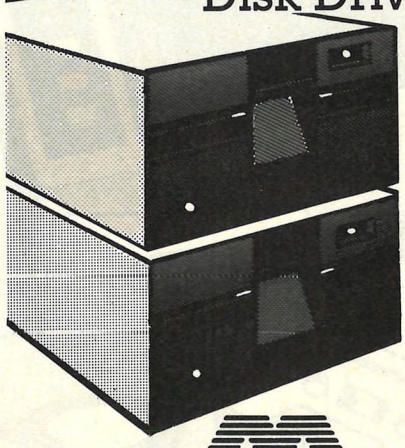

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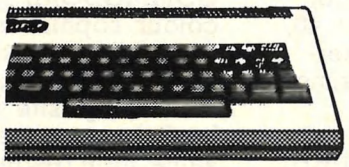

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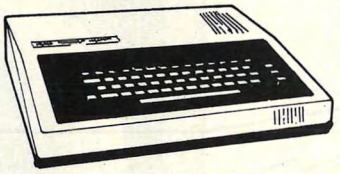

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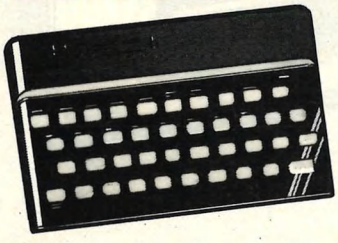

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PRESTEL

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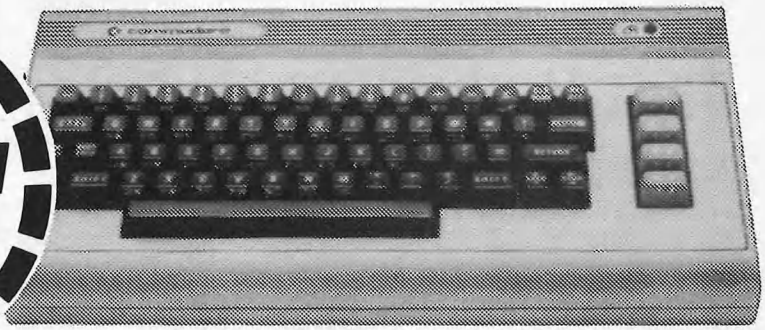

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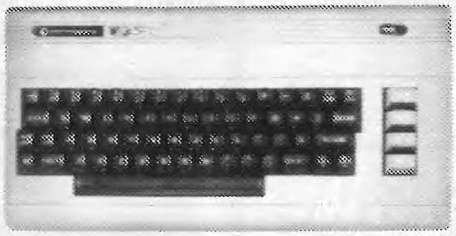

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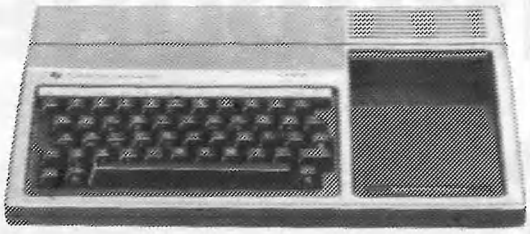

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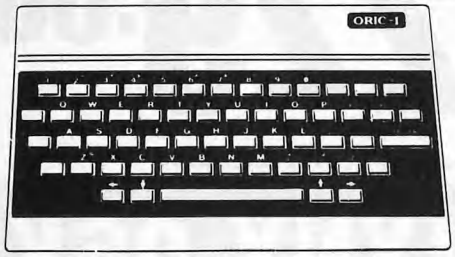

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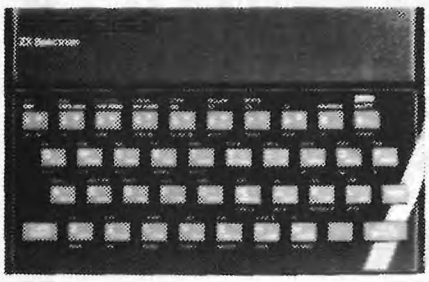
SINCLAIR ZX SPECTRUM



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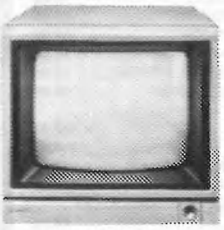

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16K RAM
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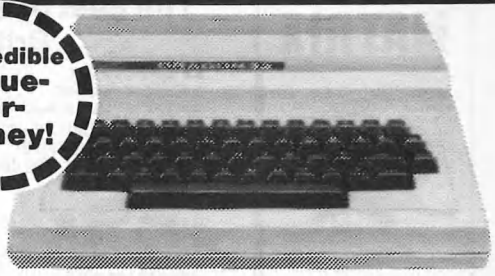
DRAGON



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WESTON-SUPER-MARE K. & K. Computers, 32 Alfred St. TEL: TBA

BEDFORDSHIRE

BEDFORD Stanad Ltd., 115 Midland Rd. TEL: (0234) 49341
DUNSTABLE Dormans, 7-11 Broad Walk. TEL: (0582) 65515
LEIGHTON BUZZARD The Computer Centre at Milton Keynes Music, 17 Bridge St. TEL: (0525) 382504, 376622
LUTON Terry-More, 49 George St. TEL: (0582) 23391/2

BERKSHIRE

READING David Saunders, 8 Yield Hall Place. TEL: (0734) 580719
WINDSOR Wycombe Video, 44 King Edward Court. TEL: (07535) 67441

BUCKINGHAMSHIRE

CHESHAM Reed Photography & Computers, 113 High St. TEL: (0494) 783373

CAMBRIDGESHIRE

CAMBRIDGE K. P. Ltd., 12a Kings Parade. TEL: (0223) 68087
PETERBOROUGH Peterborough Communications, 91 Midland Rd. TEL: (0733) 41007

CHANNEL ISLANDS

GUERNSEY Grut's, 3-5 The Pollet, St. Peter Port. TEL: (0481) 24682
JERSEY Audio & Computer Centre, 7 Peter St. St. Helier. TEL: (0534) 74000

CHESHIRE

ALTRINCHAM Mr. Micro, 28 High St. TEL: TBA (Phone (061) 728 2282 for info.)
CREWE Microman, Unit 2, 128 Nantwich Rd. TEL: (0270) 216014
CHESTER Oakleaf Computers Ltd., 100 Boughton. TEL: (0244) 310099
MACCLESFIELD Camera & Computer Centre, 118 Mill St. TEL: (0625) 27468
NORTHWICH Camera & Computer Centre, 3 Town Sq. TEL: (0606) 45629
STOCKPORT Wilding Ltd., 1 Little Underbank. TEL: (061) 480 3435
WARRINGTON Wildings, 111 Bridge St. TEL: (0925) 38290
WIDNES Computer City, 78 Victoria Rd. TEL: (051) 420 3333
WILMSLOW Swift of Wilmslow, 4-6 St. Annes Parade. TEL: (0625) 526213

CLEVELAND

MIDDLESBROUGH McKenna & Brown, 190 Linthorpe Rd. TEL: (0642) 248345

CORNWALL

ST. AUSTELL A B & C Computers, Duchy House, 6 Lower Aylmer Sq. TEL: (0726) 64463

CUMBRIA

BARROW-IN-FURNESS Barrow Computer Centre, 96 Church St. TEL: (0229) 38353
CARLISLE The Computer Shop, 56-58 Lowther St. TEL: (0228) 27710
WHITEHAVEN P. D. Hendren, 15 King St. TEL: (0946) 2063

DERBYSHIRE

ALFRETON Gordon Harwood, 69/71 High St. TEL: (0773) 832078
DERBY C T Electronics, at Camera Thorpe, The Spot. TEL: (0332) 360456

DEVON

EXMOUTH Open Channel, 30 The Strand, TEL: (03952) 4408
PAIGNTON Devon Computers, 81 Upper Manor Rd. TEL: (0803) 526303

DURHAM

DARLINGTON McKenna & Brown, 102 Bondgate. TEL: (0325) 59744

ESSEX

BASILDON Godfrey's 28-32 East Walk, Town Centre. TEL: (0268) 289379
CHELMSFORD Maxton Hayman Ltd., 5 Broomfield Rd. TEL: (0245) 354595
GRAYS H. Reynolds, 79 Orsett Rd. TEL: 0375 5948
ILFORD Woolfmans, 76 Ilford Lane. TEL: (01) 478 1307 (Opening Soon)
LOUGHTON Micro & Movie Channel, 309 High Rd. TEL: (01) 508 1216

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GLOUCESTER The Model Shop, 79-81 Northgate St. TEL: (0452) 410693

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ALDERSHOT David Saunders, 51 Station Rd. TEL: (0252) 20130
BASINGSTOKE Fisher's, 2-3 Market Place. TEL: (0256) 22079
PORTSMOUTH Computer Corner, 261 Commercial Rd. TEL: (0705) 833938
PORTSMOUTH Waterlooville G B Microland, 7 Queens Prde. TEL: (07014) 59911
SOUTHAMPTON R. J. Parker & Son Ltd., 11 Portsmouth Rd., Woolston. TEL: (0703) 434137/8
WINCHESTER Winchester Camera & Computer Centre, 75 Parchment St. TEL: (0962) 53982 (Just Opening)

HEREFORD

HEREFORD Melgray Hi-Tech Ltd., 49 Broad St. TEL: (0432) 275737

HERTFORDSHIRE

HATFIELD Microworld, 2 Crawford Rd. TEL: (07072) 64137
HEMEL HEMSTEAD Faxminster Ltd., Computer & Electrical Discount Centre, 25 Market Sq. TEL: (0442) 55044
HITCHIN Camera Arts (Micro Computer Division), 68a Hermitage Rd. TEL: (0462) 59285
POTTERS BAR The Computer Shop, 197 High St. TEL: (0707) 44417
ST. ALBANS (Herts) Clarks Computer Centre, 14/16 Holywell Hill. TEL: (0727) 52991
STEVENAGE D. J. Computers, 11 Town Sq. TEL: (0438) 65501
WATFORD SRS Microsystems Ltd., 94 The Parade, High St. TEL: (0923) 26602

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GRIMSBY R. C. Johnson Ltd., 22 Friargate, Riverhead Centre. TEL: (0472) 42031

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CANTERBURY Kent Micro Systems, Conquest House, 17 Palace St. TEL: (0227) 50200
ORPINGTON Ellis Marketing Ltd., 25 Station Sq., Petts Wood. TEL: 0689 39476
RAINHAM Microway Computers Ltd., 39 High St., Medway Towns. TEL: (0634) 376702
SEVENOAKS Ernest Fielder Computers, Dorset St. TEL: (0732) 456800
SITTINGBOURNE Computers Plus, 65 High St. TEL: 0795 25677
TUNBRIDGE WELLS Modata Computers Ltd., 28-30 St. Johns Rd. TEL: 0892 41555

LANCASHIRE

ACCRINGTON PV Computers, 38A Water St. TEL: (0254) 36521/32611
BLACKBURN Tempo Computers, 9 Railway Rd. TEL: 0254 60554
BURNLEY IMO Computer Centre, 39-43 Standish St., BB11 1AP. TEL: (0282) 54299
BURY (Lancs.) Micro-North, 7 Broad St. TEL: (061) 797 5764
OLDHAM Home & Business Computers Ltd., 54 Yorkshire St. TEL: (061) 633 1608
PRESTON Wilding's 49 Fishergate. TEL: (0772) 556250
ROCHDALE Home & Business Computers, 75 Yorkshire St. TEL: TBA

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LEICESTER Youngs, 40/42 Belvoir St. TEL: (0533) 544774
MARKET HARBOROUGH Harborough Home Computers, 7 Church St. TEL: (0858) 63056

LINCOLNSHIRE

GRANTHAM Oakleaf Computers Ltd., 121 Dudley Rd. TEL: (0476) 76994/70281
LINCOLN MKD Computers, 24 Newlands. TEL: (0522) 25907

LONDON

E6 Percivals, 85 High St. North, East Ham. TEL: (01) 472 8941
E8 McGowans, 244 Graham Rd., Hackney. TEL: (01) 533 0935
EC2 Devron Computer Centre, 155 Moorgate. TEL: (01) 638 3339/1830
N14 Logic Sales, 19 The Broadway, The Bourne, Southgate. TEL: TBA
N20 Castlehurst Ltd., 1291 High Rd. TEL: (01) 446 2280
NW4 DA Vinci Computer Store, 112 Brent St., Hendon. TEL: (01) 202 2272/3/4 (Just Opening)
NW9 Moviescope, 459 Kingsbury Rd. TEL: (01) 204 6352
SE1 Vic Odden's, 6 London Bdg Walk. TEL: (01) 403 1988
SE9 Square-Deal, 375 Footscray Rd., New Eltham. TEL: (01) 859 1516
SE15 Castlehurst Ltd., 152 Rye Lane, Peckham. TEL: (01) 639 2205
SW6 Chelsea Micros Ltd., 14 Jerden Place. TEL: (01) 385 8494
W1 Devron 4 Edgware Rd. TEL: (01) 724 2373
W1 Computers of Wigmore Street, 87 Wigmore St. TEL: (01) 486 0373
W1 Sonic Foto & Micro Center, 256 Tottenham Court Rd. TEL: (01) 580 5826
W3 Colormatic Computers, 44 High St., Acton. TEL: (01) 992 7611
W11 Electroleisure, 120 Notting Hill Gate. TEL: (01) 221 7029

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MANCHESTER Lomax Ltd., 8 Exchange St., St. Ann's Sq. TEL: (061) 832 6167
SWINTON Mr. Micro Ltd., 69 Partington Lane. TEL: (061) 7282282 Open Friday until 8 p.m.
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SOUTHPORT Central Computers, 575 Lord St. TEL: (0704) 31881

MIDDLESEX

EDGWARE Breaker 1-4, 130 High St. TEL: (01) 952 7488/8860
HARROW Camera Arts (Micro Computer Division, 24 St. Ann's Rd. TEL: (01) 427 5469
HAYES Chipstop, 1000 Uxbridge Rd. TEL: (01) 573 2511 (Just Opening)
TEDDINGTON Teddington Camera Centre, Broad St. TEL: (01) 977 4716

NORFOLK

NORWICH Sound Marketing, 52 St. Benedicts St. TEL: (0603) 667725
THETFORD Thetford C B & Micros, 21 Guildhall St. TEL: (0842) 61645

NORTHANTS

NORTHAMPTON Basic Computers & Systems Ltd., 72 Kingsthorpe Hollow. TEL: (0604) 710740

NOTTINGHAMSHIRE

NOTTINGHAM Cameo Computers, 8/9/10 Trinity Walk. TEL: (0602) 42912
NOTTINGHAM Basic, 39-41 Trent Boulevard, West Bridgeford. TEL: (0602) 819713

NORTHERN IRELAND

BELFAST Arthur Hobson Ltd., 37 Gt. Victoria St. TEL: (0232) 246336
LONDONDERRY Foyle Computer Systems, 3 Bishop St. TEL: (0504) 268337

OXFORDSHIRE

ABINGDON Ivor Fields Computers, 21 Stert St. TEL: (0235) 21207
BANBURY Computer Plus, 2 Church Lane. TEL: (0295) 55890
OXFORD Ivor Fields, 7 St. Ebbes St. TEL: (0235) 21207

SCOTLAND

ABERDEEN North East Computers, 1-3 Ellis St., Peterhead. TEL: (0779) 79900
DUMFRIES Vennals, 71 English St. TEL: (0387) 4547
EDINBURGH The Silicon Centre, 6-7 Antigua St. TEL: (031) 557 4546
GLASGOW Victor Morris Ltd., 340 Argyle St. TEL: (041) 221 8958
HAMILTON Tom Dickson Computers, 8-12 Cadzow St. TEL: (0698) 283193
KILMARNOCK Vennals, 49 Foregate. TEL: (0563) 32175
KIRKCALDY Kirkcaldy Photographic Services, 254E High St., Fife. TEL: (0592) 204734
STIRLING R. Kilpatrick, 58 Port St. TEL: (0786) 5532

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SHREWSBURY Computerama, 13 Castlegate. TEL: TBA

SOMERSET

TAUNTON Grays, 1 St. James St. TEL: (0823) 72986

STAFFORDSHIRE

STAFFORD, Computerama, 59 Forgate St. TEL: (0785) 41899
STOKE-ON-TRENT Computerama, 11 Market Sq., Arcade, Hanley. TEL: (0782) 268620

SUFFOLK

BURY ST. EDMUNDS Bury Computer Centre, 11 Guildhall St. TEL: (0284) 705772
IPSWICH Brainwave, 24 Crown St. TEL: (0473) 50965
LOWESTOFT John Wells, 44 London Rd., North. TEL: (0502) 3742

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CAMBERLEY Camera Arts (Micro Computer Division), 36 High St. TEL: (0276) 65848
CHERTSEY Chertsey Computer Centre, 1 Windsor St. TEL: (09328) 64663
CROYDON Cadcom Ltd., 96 Whitgift Centre (Next door to MacDonald's) TEL: (01) 686 8393
GUILDFORD The Model Shop, 23 Swan Lane. TEL: (00772) 0483 39115
HASLEMERE Haslemere Computers, 25 Junction Place, adj. Rex Cinema. TEL (0428) 54428
NEW MALDEN Surrey Micro Systems, 31 High St. TEL: (01) 942 0478
WALLINGTON Surrey Micro Systems Ltd., 53 Woodcote Rd. TEL: (01) 647 5636
WOKING Harpers, 71/73 Commercial Way. TEL: (04862) 61061

SUSSEX

BRIGHTON Capricorn, 1 Queens Rd. TEL: (0273) 29634
LITTLEHAMPTON Alan Chase Ltd., 39 High St. TEL: (09064) 5674/4545

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NEWCASTLE-ON-TYNE Newcastle Camera & Computer Mart, 16 Northumberland Ct. TEL: (0632) 327461

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NEWPORT (Gwent) Randall Cox, 118 Commercial St. TEL: (0633) 67378
PEMBROKE Randall Cox, 19 Main St. TEL: (064) 668 2876
PORT TALBOT Micro Gen, 6 Royal Buildings, Talbot Rd. TEL: (0639) 887730
WREXHAM T E Roberts, 26 King St. TEL: (0978) 364404/364527

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COVENTRY Coventry Micro Centre, 33 Far Gosford St. TEL: (0203) 58942
DUDLEY Computer World, 35 Churchill Precinct. TEL: 0384-238169
WEST BROMWICH Bell & Jones, 39 Queens Sq. TEL: (021) 553 0820

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WORCESTER David Waring Ltd., 1 Marmion House, High St. TEL: (0905) 27551

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HUDDERSFIELD Richards (formally Lawries) 12 Queen St. TEL: TBA
HULL The Computer Centre (Humberside) Ltd., 26 Anlaby Rd. TEL: (0482) 26297
LEEDS Bass & Bligh, 4 Lower Briggate. TEL: (0532) 454451
SHEFFIELD Superior Systems Ltd., 178 West St. TEL: (0742) 755005
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NEW SPECTRUM MEMBERS

Check **your area** there are many new **SPECTRUM** dealers throughout the **U.K.** So there's a good chance there'll be a **SPECTRUM** centre near you!

Not all stores carry every advertised item, please phone before making a journey — Prices correct at time of going to press E. & O.E.

SINCLAIR ADD-ONS
MAJOR PRICE BREAKTHROUGH!

MICROCARE KEEPS YOUR COMPUTER HUMMING!

Spectrums and Dragons only £19.90 (inc. P + P)

ZX81 only £12.50 (inc. P + P)

Fully guaranteed for 12 months.

No, you're not dreaming! Those are the prices charged by MicroCare for repairing any electronic fault, however serious, in the above computers. They are £££££'s below the price of Sinclair's repair service, **and we give a guarantee!**

We'll return it promptly, and we'll quality check your unit before it leaves our service centre.

We have the experience it takes. We have the parts on hand. So act now. Let MicroCare get your computer humming again!

When sending in your computer, please enclose a brief description of the fault, and make sure that your address is clearly indicated.

Cheques to be made payable to MicroCare,

Order ref: **MC1 £19.90 inc. P + P**

MC2 £12.50 inc. P + P

16K Memory extension for only £15.99!

FABULOUS SINCLAIR ADD-ON OFFER FOR ZX81 OWNERS

These are the real thing. ZX81 memory extensions made for the USA and specifically screened to stop radio interference.

- ★ **no soldering**
- ★ **easy to fit**
- ★ **simply plug in**
- ★ **no loss of memory through wobble or white out**

Fully Guaranteed for 12 months

ME1-16USA £15.99 plus 60p P + P

FANTASTIC ZX81 & SPECTRUM SS1 SPEECH SYNTHESISER SIZE 3½" x 5¾" x 1"

- ★ Making amazing speech effects with your ZX Spectrum.
- ★ Specially designed for use with your Spectrum. Just plugs in, no dismantling or soldering.
- ★ No power pack, leads, batteries or other extras.
- ★ Ample volume from built in loudspeaker, Manual Volume Control on panel. Can be plugged in to existing hi-fi system.
- ★ Uses no memory addresses.
- ★ Free Dictionary of Sounds.

SS1 SPEECH SYNTHESISER £39.00 plus 60p P + P

NEW

TAPE LOAD ANXIETY?

Vu load takes the frustration out of loading your ZX81 or Spectrum programmes.

- ★ **helps to ensure programme load every time**
- ★ **monitors tape output level**
- ★ **gives positive save indication**
- ★ **detects blank tape without disconnecting cassette wires**
- ★ **ready to use – no wiring**

TL £19.99 plus 60p P + P

NEW

MICRO TAPE

save it – first time on American microtape

- ★ **Specially designed for use with micro computers**
- ★ **Low drop out occurrance**
- ★ **Uniform coating**
- ★ **High saturation level**
- ★ **So good, we can guarantee them for 12 months**

AUDIO DIGITAL AD.C12 – 55p; AD.C15 – 60p; AD.C20 – 65p; + 40p P + P

NEW LOW PRICE Series B ONLY £20.50!

Spectrum 16K-48K

With our ME48 memory expansion add-ons your Spectrum can increase its capacity by up to three times.

- ★ **no soldering**
- ★ **easy to fit**
- ★ **simple to plug in**
- ★ **fully guaranteed**
- ★ **no loss of memory through wobble or white out.**

NB. Before ordering your Spectrum add-on please check which Spectrum you have in your possession. At the back of the ZX Spectrum the metallic contact strips can be clearly viewed. In the series A the space separating the strips is the same width as the strips. In the series B the strips are twice as wide as the space between.

SPECTRUM

ME16-48 Series A £34.50 plus 60p P + P
Series B £20.50 plus 60p P + P
ME16-80 Series B £46.00 plus 60p P + P

ZX81

ME1-64 £44.25 plus 60p P + P

FITTING/TESTING SERVICE. While you wait, personal callers Monday – Friday 9.30-5.00, £3.00. By return of post £7.00.

NEW

LEVEL-VU PRISM

Allows you to see your tape counter without moving from your seat!

- ★ **attaches easily to recorder body or lid**
- ★ **fits most recorders including Radio Shack, Vic-20, Atari**
- ★ **greatly magnifies counter numerals**

LVP £3.99 plus 40p P + P

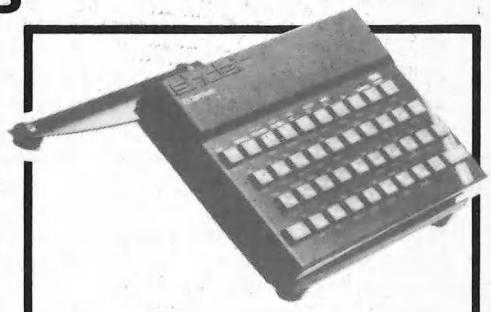
COMPUTER STANDS

POWER BASE

Raised stand for ZX81 and Spectrum. Fitted LOAD/SAVE switch, and power ON/OFF for screen clearing. Saves wear and tear on connections. Front lip holds computer in place. No soldering, comes complete with all necessary plugs and cables.

Spectrum ref. PBS1 £13.50 plus 95p P + P

ZX81 ref. PBZX81 £13.00 plus 95p P + P



COMPUTILT STAND

Designed to tilt the computer to a better working position. Front lip holds computer in place. Also useful as a document stand when entering information.

Spectrum or ZX81 ref. CS1 £4.50

plus 60p P + P

WOBBLE STOPPERS

At last, a fool proof method of avoiding ZX81 whiteouts caused by Ram-Pack wobble. Simply turn the plastic thumbscrew until the Ram-Pack is held firmly against the ZX81. No soldering no stick-on pieces, just common sense!
Flat or tilted models.

Small flat ZX81 and Ram-Pack ref. SW

plus 60p P + P **£5.25**

Small tilted for ZX81 and Ram-Pack ref. STW

plus 60p P + P **£6.25**

Large flat or tilted for ZX81 and Ram-Pack and Printer ref.

LW **£5.75** flat LTW **£6.75** tilted plus 60p P + P

COMPUTER ADD ONS 7-9 Thane Works, Thane Villas, London N.7. Tel: 01-609 7919

Trade enquires welcome

ALL ITEMS NORMALLY DESPATCHED WITHIN 24 HOURS
Please tick appropriate box to order your Computer Add-On.

MC1 ☐ MC2 ☐ ME16USA ☐
ME16-48 Series A ☐ Series B ☐ SS1 ☐
TL ☐ ADC12 ☐ ADC15 ☐ ADC20 ☐
ME16-80 Series B ☐ ME1-64 ☐
LVP ☐ PBS1 ☐ PBZX81 ☐ CS1 ☐
SW ☐ STW ☐ LW ☐ LTW ☐

NB. Add Post and Packing to the price of each item.
I enclose a cheque or postal order for_____ made payable/crossed to Computer Add-ons or MicroCare or I would like to pay by Access or Barclay Card and I enter my number and signature accordingly.
*Allow 28 days for delivery.

☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Signature _____
Date _____

Name _____
Address _____
Occupation _____

YC6

COMPUTER ADD-ONS
7-9 Thane Works, Thane Villas London N7

dk'tronics

ZX KEYBOARD FOR USE WITH 81 SPECTRUM

Our new cased keyboard has 52 keys, 12 of which are used for the numeric pad. The numeric pad offers useful features, you can cursor with one hand and it will be a boon for anyone who enters a lot of numeric data. The pad is a repeat of the 1 – 9 keys, it also has a full stop and a shift key. The numeric pad keys are red in colour, the normal keyboard keys are grey, with the case being black, which results in making the keyboard very attractive. The keyboard case dimensions are: 15" x 9" x 2½". The computer (either 80/81 or Spectrum), fits compactly inside.

You will have to remove the computer from it's original case, it is then screwed to the base of the case. The case has all the bosses already fitted and the screw holes are marked. Also fitted inside the case is a mother board (81 model only) which allows 16K, 32K and 64K to be fitted in the case. All connectors are at the rear of the case i.e. Power, Mic, Ear, T.V. and the expansion part. The case is large enough for other add-ons also to be fitted inside. One of these could be the power supply then you could very quickly fit a mains switch or a switch on the 9V line. This means you have a very smart contained unit.This case does not stop you from using any other add-ons that you may have eg Printer etc. We are convinced that this is the best keyboard available at present. It offers more keys and features than any other keyboard in it's price range.

NOTE...

The case can be purchased separately with the keyboard aperture uncut, therefore if you possess one of our early uncased keyboards, or in fact, any other suppliers' keyboards these could be fitted. The keyboard is connected to your computer by a ribbon cable and this has connectors fitted which simply push into the Sinclair connectors. It is a simple two minute task and requires no electronic skills. This keyboard does not need any soldering. Please specify on order whether you require the ZX81 or Spectrum case.

SPECTRUM MODEL

This is supplied with Spectrum legends, and a slightly different base for fitting the Spectrum inside, again, all the connectors are at the rear of the case and there is plenty of room for the power supply (and other add-ons). Should you wish to change, we can supply both the Spectrum legends and details of updating your case which will enable modification from the ZX81 to Spectrum. PLEASE specify on your order whether you require the ZX81 or Spectrum inside.

£45

MEMORY FOR ZX 81

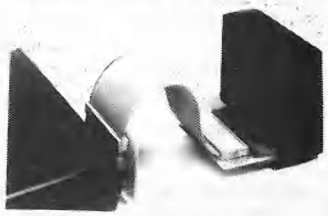
16K Memory £22.95
64K Memory £52.95
16K (Uncased) £19.95
64K (Uncased) £49.95

SPECTRUM MEMORY

MKI £30
MKII £30

FLEXIBLE RIBBON CONNECTOR

If you have ever had white outs or system crashes this could be the answer. It stops the movement between the computer and the RAM expansion, it is supplied with a ribbon 6 inches long, with a male connector at one end and a female at the other.



ONLY £10

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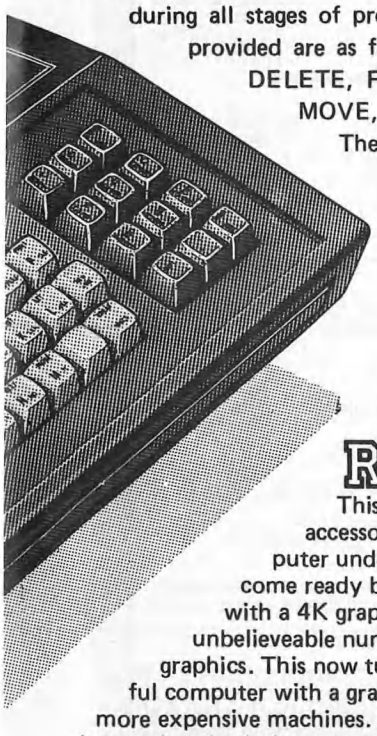
Essex CB11 3AQ. Tel: (0799) 26350 (24 hrs) 5 lines.

ZX 80/81 SPECTRUM HARDWARE

SPECTRUM/81 TOOLKIT BOTH AT ONLY £6.95

This is the toolkit which won acclaim in the feature in the August 1982 issue of Sinclair User. "It is the most impressive programm, fast in execution with clear and full instructions . . . . it stands out from the rest of the field". The ZXED is a powerful editor for use on the expanded ZX81. It is intended for use by the serious BASIC programmer and offers several useful and time saving features most helpful during all stages of program development. The facilities provided are as follows: ALTER, BYTES, COPY, DELETE, FIND, HELP, INSERT, KEEP, MOVE, RENUMBER, AND VERIFY.

The Spectrum Toolkit contains most of the features above plus autoline numberer and append, and will run in the 16K and 48K Spectrum.



4K GRAPHICS ROM £24.95

This module unlike most other accessories fits neatly inside your computer under the keyboard. The module come ready built fully tested and complete with a 4K graphic ROM.This will give you an unbelieveable number of extra pre-programmed graphics. This now turns the 81 into a very powerful computer with a graphic set rarely found on larger more expensive machines. In the ROM are lower case letters, bombs, bullets, rockets, tanks, a complete set of invaders, graphics and that only accounts for about 50 of them, there are still approximately 400 left (that may give you an idea as to the scope of the new ROM). However, the module does not finish there, it also has a spare holder on the board which will accept a further 4K of ROM/RAM. This holder can be fitted with a 1K/2K/RAM and can be used for user definable graphics so you can create your own custom character sets.

SPECTRA-SOUND

The so called speaker in your Spectrum is really only a 'buzzer'. With the DK Tronics "SPECTRA SOUND" you can generate fully amplified sound through the speaker on your T.V. set. SPECTRA-SOUND is a very simple but highly effective add-on. This means that you no longer have a faint beep but a highly amplified sound, which can be adjusted with the TV volume control.

The SPECTRA SOUND fits compactly and neatly inside the Spectrum case and is connected by three small crocodile clips.

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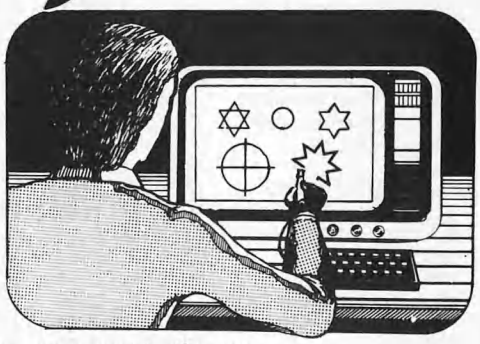

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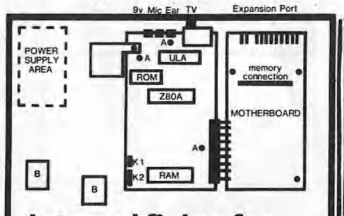

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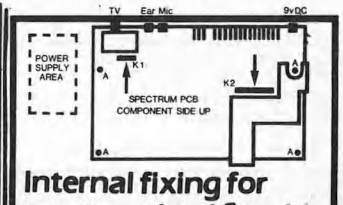

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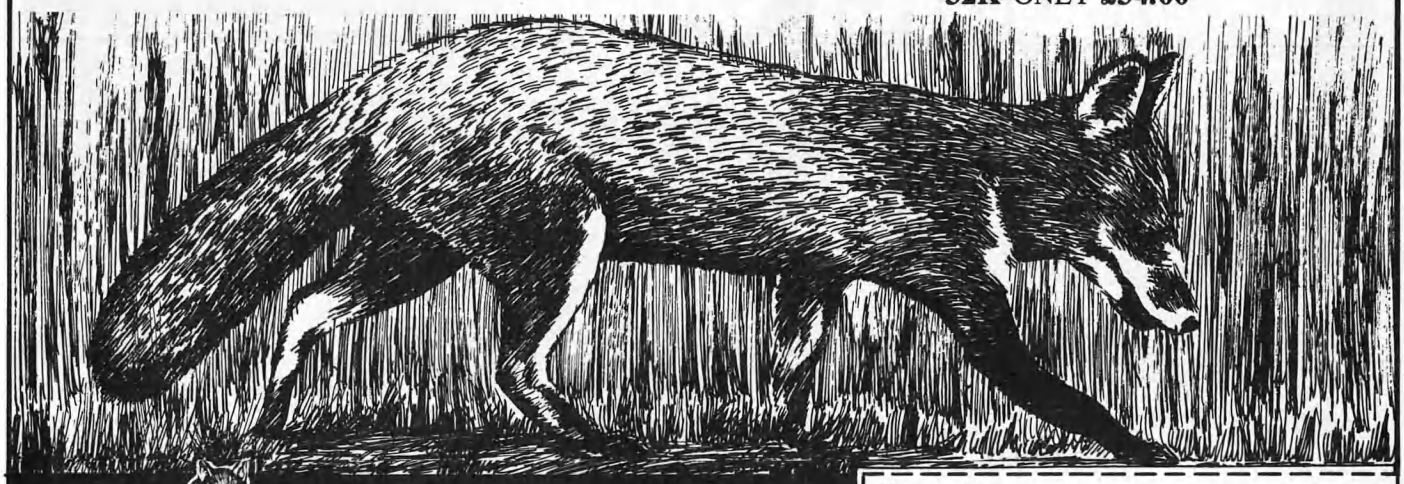

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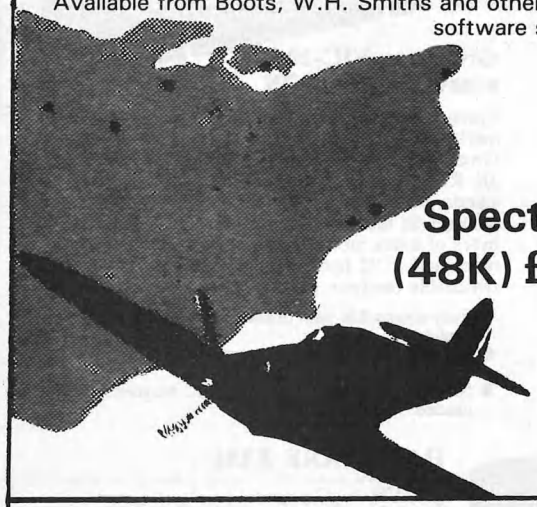

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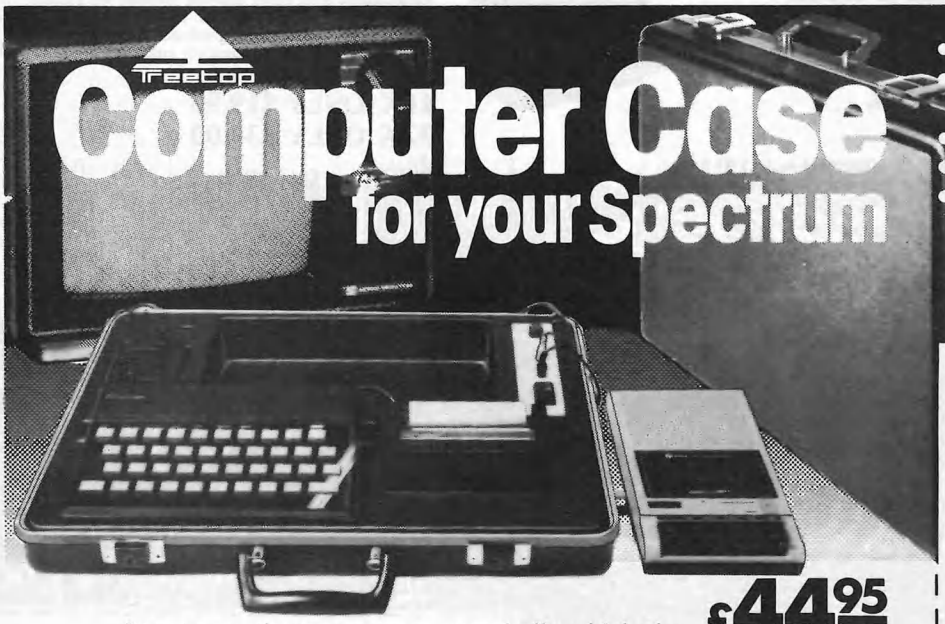

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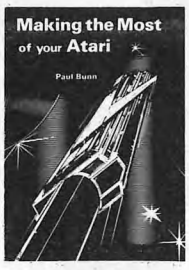

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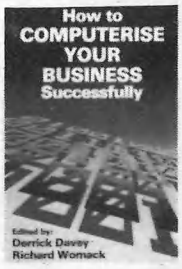

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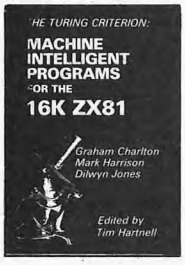

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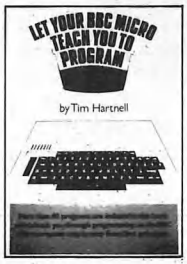

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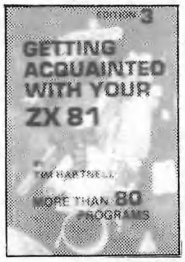

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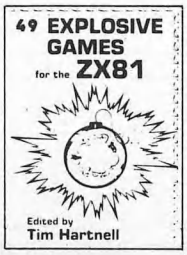

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That feast for computer enthusiasts was typical of the value which Your Computer readers have come to expect. But publishing larger and larger issues means that production and mailing costs have increased and so we have reluctantly decided that the subscription rate must go up. So as from the October issue we will be asking you to pay £10.50 for a year's subscription.

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YOUR LETTERS

SAVE ME FROM ADVENTURE

Deep into my Agatha Christie I hardly heard the surreptitious suggestion "Why don't we get a micro?"

"A micro what?" I asked carelessly, my mind more engaged on the first body in the conservatory than the promises of a microwave or even a microscope.

"You know, a microcomputer", came the knowledgeable reply.

I should of course have decreed there and then that no computer, micro or otherwise, would ever enter our home. Next time I"ll know. The arrival of the black box caused a fuss more generally applicable to the birth of kittens or the death of a great aunt.

We spent long hours playing all kinds of zap and aliens games. Never ending beep-beep-beep, boing, zap and splat, rather like a sort of animated *Beano* with sound. The tapes multiplied, the aliens got nastier and his scores went off the top of the counter. Mine stayed in the hundreds.

Then we bought a maze game and ate apples all day. A definite improvement — my scores rocketed and at last I was the one with eyestrain. We began buying a magazine or two. We read such delights as *Peeking and Poking* and *Debugging Your Program* — akin to delousing?

I had just begun to delight in the intricacies of machine code, getting excited about LDRs and RRCAs and how to collapse my stack, when he triumphantly produced an adventure game.

I tried to explain that I didn't *want* to steal someone else's treasure or chop off a goblin's head — I'm just not violent or materialistic. Golden chalices would simply look out of place on our table.

Every day of the week he rushes home from work to see if he can outwit the witch, swim the river or rescue the helpless princess. My suggestion of saying please to the goblins was met with a roll of the eyes and a "Shshsh — I'm thinking".

Still, at least I can remain undisturbed to discover the identity of the murderer after all. And of course, make the coffee while he is busy rescuing yet another princess in distress.

A M Morton, Kew, Surrey.

ARCADIA RAVE

The reviews would be greatly improved if the reviewers spent more time trying out the programs.

In the July issue, Meirion Jones said that Arcadia was "just a lacklustre version of Galaxians" but that Schizoids — by the same company — was "much better". This is patently untrue! If Mr. Jones had played these two games for some time he would have discovered that Arcadia has 12 screens of totally different aliens, all of which are anything but dull, whereas to score points in Schizoids all you have to do is avoid the rubbish. The software shop that I go to sent a batch of Schizoids back after testing them because they want to be seen selling only the best software.

Also, why review these two and Molar Maul without reviewing Ah Diddums?

Finally, why not bring back the software rating table you used to have at the end of articles. It makes it a lot easier to pick out the good software without having to ask around.

Andrew M Hay, Sidmouth, Devon.

PROGRAM SAVE

In his article entitled Food for the Dragon — *Your Computer*, July — Vincent Cockett used Poke 114,25 to stop the reset button being used to break his progam, stating that the button's subsequent use would result in the computer restarting as if it had just been turned on. This proved only too true and after my loss of the entire program by using Reset in the middle of the program I wrote the following short machine-code routine for the Dragon which will reinstate any program which has been Newed in this way. The program will also work after a normal New or after any other crash providing that the power supply has not been interrupted.

The routine will bring back a lost program on entry of Exec 32750. However, the program will not work if a new Basic line has been entered or a new variable assigned.

```
10 CLEAR 200,32749
20 DATA 158, 25, 189, 131, 243,
   48, 2, 159, 27, 159, 29, 159,
   31, 57
30 FOR T=1 TO 14
40 READ A: POKE 32749+T,A
50 NEXT T
```

Andrew Williams, Southport, Merseyside.

GENERATING SOUND

I saw the Mozart lives article — *Your Computer*, March 1983. I already had a programmable sound generator, the Zon X-81 by Bi Pak — and wondered if it would work. After a lot of typing I eagerly connected my sound generator and hey presto! It did not work. After all that typing I was not going to give up. I worked out what changes needed to be made and it worked perfectly.

If anybody would like to use their Zon X then the following changes will have to be made.

In line 3 change the values of R and RO:

```
LET R  = 223
LET RO =  15
```

Change line 4 to:

```
4 LET PL = 32350 : IF PEEK 31416
<> 148 THEN LET KY = B/KY
```

Then enter as direct commands:

```
POKE 32430,223
POKE 32470,15
POKE 32479,223
```

As I said earlier it takes a lot of typing but it is well worth it as it shows the capability of the PSG and makes a change from the usual explosions, zaps and so on.

Kevin Sibley, Slough, Berkshire.

INTEGER STORE

In your July issue Nick Goodwin says he has not found much use for multi-dimensioned string arrays. One use on the ZX-81 is to store a list of positive integers in two-byte form, as otherwise the ZX-81 lacks this facility.

Integers up to the limit of 65535 can be placed in a two-dimensional string array of the form A$(N,2) with the lines:

```
LET A$(N,1) = CHR$ INT
  (integer/256)
LET A$(N,2) = CHR$(integer-CODE
  A$(N,1)×256)
```

This makes it possible, for instance, to store all prime numbers up to 65535 in less than 16K. An undimensioned string cannot do this because, as Mr Goodwin points out, in practice it cannot be expanded much beyond 7K. Such a list is sufficient for testing for primes up to the ZX-81's limit of accuracy.

Barrington Bayley, Telford, Shropshire.

LITTLE BUGS

A little bug crept into the Ace sounds article in your July issue. It occurs in the word defined as Note. The mnemonics

```
IN A,(O) and OUT A,(O)
```

both need a number after them to function correctly. In this case the numbers are both zero, so the word Note should read:

```
CREATE NOTE 205 c, PAUSE , 219 c,
  0 c, 205 c, PAUSE , 211 c, 0 c,
  29 c, 32 c, 243 c, 201 c,
```

Another problem occurred in Mark Carne's Dangerman in the Software File of the same issue. Although the actual program was correct there was no way of telling what character the question mark in line 1 was. It should have been CHR$ 78. To enter this

NOBBLING SPECTRUM SOFTWARE

Quote from your April news item, Double Dragon. "Commodore . . . would only say that price was 'all to do with what the market will bear — not to do with what it costs to make'." Quote from your February Response Frame, Time Bomb: "In the first place copying commercial software is robbing the programmer of his/her royalties . . . I can have little sympathy for you if . . ."

Atari software usually sells at between £10 and £30. Also, it is unusual for a Spectrum program to set one back by more than £10. These prices refer to cassette tapes. Of course, games software for the Atari machines is almost certain to be more satisfying but this is a function of the machine, not of the software houses.

In fact, upon careful examination of software pricing one is quickly struck by the fact that the price of commercial software is positively correlated with the price of the host machine. Slight non-linearities in the correlation can be accounted for by introducing the gullibility factor associated with buyers of particular machines.

I nobble software. I do so to acquire a program for my personal use. I also buy. I won a Spectrum and, as a student, I am temporarily affluent. This mixture of buying and procuring makes the average price more realistic. There is no way a program can be made impregnable to someone who is *au fait* with the host machine, so long as the expenditure of effort continues to be rewarding.

If the programmer finds himself suffering from reduced income and if lots of these creative gents so suffer, then their collective misery may yet bring upon them the realisation that it is they and we who count in this sordid business, and they may send their middlemen to join the Golgafrincham Fleet.

Probably not, though. The consumer electronics industry, which now has a good grip on micros, will not allow it. Not that I mind. I keep my overheads low. I manage. But now and then I feel really sorry for others, the consumer classes, those poor unimaginatives, terrified by imaginary time-bombs.

Tim Magee, Bradford, West Yorkshire.

just enter the following Poke, not forgetting to put a space after the graphic T:

POKE 16517,78

Incidentally, I was very impressed by "Ace sounds".

Timothy Skinner,
Hoveton,
Norfolk.

SWAP FAULT

Although I think I checked my Swap program in the July issue, a fault sneaked in.

I discovered it when I got a letter from R J Fox, Surrey, another *Your Computer* reader, who asked me how to change the program to divide a 32K RAM into two 16K parts.

First the error in the original program. Even if it might seem to work, it only swaps two 6K parts instead of two 8K parts. To correct this, change the contents of 16537 to 1F H.

To split a 32K RAM into two 16K parts, start by Poking 16389,127 and New. After this, change 16531 to 80 H and 16537 to 3F H. All USR-routines start at the same adresses.

Peter Havlykke.

HARDWARE

In the article Submarine Mission in the August issue of *Your Computer* details of hardware were omitted. The two-computer version — to be covered in *Your Computer* October was written around the PSGIO — sound/IO — board used for the Mozart programme in your March edition. One board is needed for each computer, though only a single connecting cable is necessary. Like the cassette, both are available from Protek Computing, Clydesdale Bank Bldng, S. Queensferry, Scotland.

Prices are as follows: PSGIO board, each £19.25 inc p/p; cable £4.75 inc p/p.

Rod Hopkins,
Dunfermline,
Fife.

The correction for the 48K version of the Spectrum 3D rotator in *Your Computer*, August Letters, itself stands in need of correction. F& is of course a printing error and should read F7.

Lines 40 to 60 in program 1 of the Vic Saucer Attack in the August issue have been corrupted. Fortunately this program just prints the title screen and can be left out. More importantly some of the data items in program 2 are illegible. The last three numbers in line 200 are 68, 254, 254; the last five in line 210 are 124, 254, 254, 16, 56; and the last three in line 220 are 124, 254, 254.

If you are unable to key in the program but would like a tape of it, send £3.50 to: Damian McComb, 23 Woodland Drive, Quarry Vale, Dungannon, Northern Ireland.

In August's BBC Squeeze program line 4090 should contain the number 155 instead of 150.

EDITORIAL

THE CEASEFIRE HAS BROKEN. After 16 months of silence the big guns of British home computing, Sinclair Research and Acorn, opened up on the same day. Both the Microdrive and the Electron have been on the verge of being launched for so long that neither holds any real surprises — beyond the fact that they now really do exist.

What is surprising though is that the Microdrive is likely to have a greater bearing on computing in the immediate future than the Acorn computer. It is probably the first time an add-on has upstaged a new micro from any company let alone one from a manufacturer as important as Acorn. With the Microdrive Sinclair has proved that a product need not be mechanically sophisticated to be technologically significant.

The months of waiting may indicate that the Microdrive has been costly to perfect even though the components it contains are inexpensive. Because it costs little to build, in a year's time you will probably be able to buy the Microdrive and Interface 1 together for £50 and blank cartridges for £2. After all the minimum price of the 16K Spectrum has dropped from £125 to £90 in just four months.

But even at its present price the Microdrive will affect demand for storage devices above and below it in cost. It fills the yawning gap between the sluggish cassette and the expensive floppy disc drive.

Other companies have also been aiming to make that bridge — Coleco, for example, and Texas Instruments — whose £109 Wafertape is due shortly. Providing Sinclair's product proves sufficiently reliable the price of floppy disc drives may be forced down to compete for sales to those who want fast mass storage for their home micro. At the moment the cheapest disc drive costs three times as much as the Microdrive.

In the 1960s the Philips compact cassette knocked out the reel-to-reel as the main erasable recording medium. Many are now asking whether the Microdrive will in turn deal a similar blow to the cassette.

Sinclair's drive is part of a two-pronged attack on cassettes. His Interface 2, due to be launched later this autumn has a port for cartridges as well as a joystick facility. With plug-in cartridges available for the Spectrum — the machine that sells more cassettes than any other — the effect on the way software is sold in this country could be dramatic.

At the moment cartridges make up only a tiny percentage of all program sales in the UK but in the States, where all the big-selling micros have ROM cartridge ports, there is a fifty-fifty split. For machine owners plug-in modules rule out loading problems; for software manufacturers they reduce the risk of piracy and can justify higher selling prices.

The Microdrive itself could also have something to say on the matter of piracy — but only if Sinclair sells tapes to the software houses at a low enough level to make the difference between a blank and a commerical program as small as possible.

Using the Microdrive the sort of software that runs on the Spectrum will become more ambitious: mass storage favours games of strategy, such as board-games and complex adventures, as well as the more serious spreadsheet programs that could load VisiCalc-type files from the stringy-floppy.

It is clear that Sinclair has transformed the Spectrum without making any changes to the machine itself. But if only Sinclair would produce a real keyboard, a Spectrum-like machine incorporating two Microdrives could out-perform micros which cost more than £1,000.

How to write for *Your Computer*

We called this magazine *Your Computer* precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's — this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page — that's as it appears in the magazine and includes illustrations.

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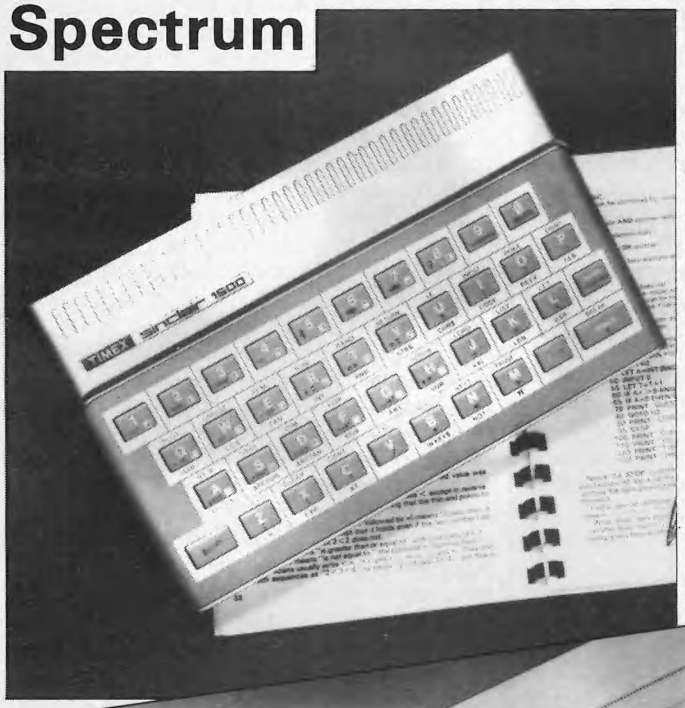
Today's American Timex-Sinclair 2000 could be tomorrow's British Spectrum



NOW THAT THE NEW range of Timex Sinclairs has gone on sale in America the implications are clear for Britain. Sinclair's launch of the Interface II in September which allows cartridge software and joysticks to be plugged into the Spectrum is only a temporary measure. To keep the Spectrum competitive as Texas, Atari and almost everyone else drops their prices to £100 Sinclair will have to build in even more features. Although he plans to move into the 16-bit arena Sinclair is not planning to move out of the games machine bargain basement just yet. A Spectrum with built-in cartridge and joystick ports together with three channel sound and a better keyboard around fit the bill. This is almost exactly what the Timex Sinclair 2000 is. The Spectrum lookalike Timex 1500 is merely a ZX-81 with a built in 16K RAMpack.

In the 1980's a microbus was a red VW van full of hippies. Now a Swansea Sord dealer called Coteglade has appropriated the word to mean a double-decker loaded with microcomputers. "There is no way that a person in Bangor or Aberystwyth is going to travel to Swansea simply to see us" says Coteglade's Andy Shercliff "so we must go to them".

Dragon — speak to me

NOW YOUR DRAGON will be able to articulate — a synthesiser enabling speech to occur simultaneously with graphics is available from JCB Microsystems.

Depending on length of individual words, around 40 words can all be spoken from one command. Five new Basic commands are introduced when the module is plugged in. The Say command controls around 200 predefined words, but you can create your own vocabulary from a set of 64 allophones, or speech sound components.

The £37.95 speech synthesis module is based on the General Instrument SP0256 Speech Processor. Apart from the Texas Instruments synthesiser, which is also used in the BBC, there is only one other chip, the Votrax, in current use for this end of the market.

CRL names the fifth man

THE SMILE that says I've finished. Following three months of after-school programming, 15-year-old Richard Taylor has put the final touches to Fifth, an extension to Spectrum Basic for the machine-code-shy games programmer.

Taylor is also author of the highly successful Computer Rentals High Resolution program for the ZX-81, the software equivalent of a course of monkey glands for Sinclair's aging machine.

CRL boss Clement Chambers is clearly deeply impressed by Taylor's software writing: "After the hi-res program I thought 'Who is this masked man'." At £9.95 Fifth offers 25 commands and 13 extra functions for fast and smooth animation and will also help you create more impressive sound effects.

It is interrupt-driven and so is unaffected by the speed of Basic. Its main advantage for the layman over machine code is that a Fifth routine can be nested in a Basic program and because of its Basic-like format reveals at a glance just how it works and what it is there for.

Sinclair prize for breakfast

SNAP, CRACKLE, POP, zap, zap, zap; Tony the Tiger says Sinclair is Grrreat! Instead of the traditional plastic cartoon characters which drop out of the box into your bowl of cornflakes, Kellogs and Asda stores have come up with a new way to sell more cereals. From 12 September to 8 October anyone buying a packet of Frosties and a packet of Rice Krispies from an Asda store will be able to enter a wordsquare competition to win £250 of Sinclair goodies. Each of the 93 stores will have a prize to give away consisting of a 48K Spectrum, ZX Printer and ten Sinclair cassettes ranging from Vu 3D to Horace goes skiing.

Prices — Texas and Atari enter the £100 bargain basement

TEXAS INSTRUMENTS has set off another avalanche in computer prices by dropping the 16-bit TI-99/4A from £150 to £99. Better design has made the cuts possible. Atari is reacting by dropping the price of the 400 to around £100 and the 800 to £200 in order to make way for the new 600XL which arrives this month for £159 and the 800XL which will cost £249.

Rumbelows has taken £10 off the 16K Spectrum, to £89.95 and Sinclair is selling a ZX-81 starter pack which consists of ZX-81, RAMpack and a free software cassette for £45. Two years ago it would have cost you £125. With ZX-81s wholesaling at less than £20 further cuts are likely. The Colour Genie previously £199 for 16K is now on sale at £168 for 32K plus £40 worth of free software.

The Aquarius is not being officially discounted by Mattel, although Silica Shop is offering the 4K machine with 16K of RAM for £99. The RAMpack would ordinarily cost £29.95. Sord has already sliced the M-5's price by £40 to £149.95. Existing M-5 users will be able to obtain the Basic-G graphics cartridge, ordinarily worth £35 for free.

Dragon Data believes that "There are two market leaders as far as we're concerned — Sinclair and Dragon," and to this end a 64K Dragon will soon be introduced for less than £200. A Dragon 128 is also planned. Officially Commodore who helped to start the price collapse by reducing the CBM 64 to £239 will only say "Everyone else is fighting us," but in America the 64 is set to drop to $99 eventually. In Britain the price could be £150 this year and £99 next with the Vic-20 selling for unbelievably low prices.

Your Computer breaks record

YOUR COMPUTER is now much the biggest-selling computer magazine in Britain, and that is official. The latest figures from the Audit Bureau of Circulations which keeps watch on magazine and newspaper sales shows that *Your Computer* sold an average of 120,488 copies each month for the first half of this year. No other computer magazine has yet broken the magic 100,000 barrier. When *Your Computer* started up in June 1981 it was Britain's only home computer magazine. It started as a bimonthly with a 40,000 print run but was such a success that it went monthly in October of the same year.

Your Computer artist's impressions of the new range of Sinclair micros. The decision to move up from 8-bits to 16-bits has delayed their introduction but both the desk-top and the portable should come next year.

ZX-84 sweet 16-bitter

WHATEVER SINCLAIR may do to freshen up the appeal of his 8-bit Z-80 based ZX-81s and Spectrums he knows that the future lies with 16-bit processors with greater speed that can address more memory.

The core of his plans for 1984 is a £300 machine designed around a Motorola 68000 16-bit processor, which will compete with business machiens like the IBM PC which can cost ten times as much. Sinclair's machine will incorporate Microdrives which will make it slower than its disc-based rivals but will make it easier to make it portable.

Sinclair would like to build the flat screen into the project — now codenamed ZX-84 — but delays may make that impossible. His first flat screen TV will now probably be launched in October and so it may not be possible to produce the larger flat screens for the ZX-84 till the middle of next year.

Sinclair watchers speculate that the ZX-84 will also contain a Z-80 chip, partly to encourage current ZX fans to move up.

Olympus is offering a pocket-sized microcassette recorder designed specifically for loading home computers. In addition to storing programs on CT15 tapes the Pearlcorder C100 can be used as a conventional dictation recorder. The only catch is the price, around £70 when it is launched next month.

Apple falls on the MPF II

WHEN THE MICROPROFESSOR MPF II appeared, with the performance of an Apple for a fraction of the price it looked too good to be true. Now Apple has obtained a high court order restraining Sirtel from selling the Microprofessor in Britain. Apple's Mike Spring claims that the MPF II which is built by Multitech in Taiwan contains a copy of the Apple ROM.

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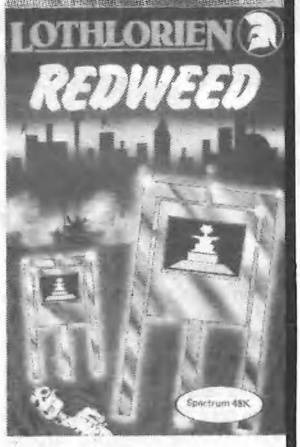

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☐Flight Simulator	Psion	ZX-81
☐3D Grand Prix	D. K. Tronics	ZX-81
☐Hobbit	Melbourne House	Spectrum
☐Jet Pac	Ultimate	Spectrum
☐Jumping Jack	Imagine	Spectrum
☐Krell	Rabbit	Vic-20
☐Krazy Kong	Software City	Vic-20
☐Manic Miner	Bug Byte	Spectrum
☐Pimania	Automata	ZX-81
☐Protector	Quicksilva	BBC
☐Q S Synthesiser	Quicksilva	BBC
☐Shamus 2	Synaps	Atari
☐Starship Command	Acornsoft	BBC
☐Transylvanian Tower	Shepherd	Spectrum
☐Traxx	Llamasoft	Vic-20
☐Winged Avenger	Workforce	Spectrum

My Talking Computer will teach me to tell time and learn tables

YOU ARE NEVER too young for computers says Burke C Pullman of Microspeech. The first product from Microspeech designed to demonstrate this is a talking computer for 3 year-olds and up. For around £60. My Talking Computer comes complete with a suite of programs ranging from a talking clock which Microspeech claims can teach a child to tell the time in less than a day, to tables programs, calculations and games.

Burke C Pullman says that they adopted a non-standard keyboard because "the Qwerty keyboard is intimidating." Each program has a separate overlay for the spillproof keyboard and the overlays are bound into a book. When the child pushes the square marked On an American woman's voice asks him or her to press Go and then asks questions or plays games which require the child to respond by pushing the correct areas of the keyboard. The most spectacular program is the talking clock which has clock hands instead of the keyboard which the other programs use. The voice issues commands like "Set the hand to two thirty" and soundly ticks-off anyone who gets it wrong before eventually giving instructions to get it right. The Talking Computer has been used with some success in a remedial unit at Fountaindale School.

The machine is battery powered and sturdily built to resist the ravages of young children. Inside it has an 8-bit processor not entirely unlike a 6502, 28K of RAM and a massive 128K of ROM containing 21 programs. The computer will accept further 128K and 256K ROMs which will deal with music, learning foreign languages, and more games. My Talking Computer was designed in Britain by Microspeech and Electroplay and is manufactured in Hong Kong. It will be available in High Street stores from October.

Sweet Talker is a new plug-in speech module for the Spectrum from Cheetah Marketing. It is an allophone speech device with a built-in speaker. Cheetah promises "no more lonely nights — a companion for just £34.95" presumably referring to the time it will take you to program in speech one sound at a time. Also illustrated is Cheetah's 32K RAMpack for the 16K Spectrum, which costs £39.95. Cheetah is on 01-240 7939.

Snow white software from magnificent 7

SEVEN LEADING U.K. software houses have formed the nucleus of an organisation which says it is committed to maintaining promised mail-order delivery times, replacing defective stock and dealing promptly with customer and dealer complaints.

Gosh, as Batman would say — and indeed GOSH is the acronym formed from the new organisation's title, the Guild of Software Houses. The seven sisters of the British software world who founded GOSH are Bug-Byte, New Generation, Virgin, Salamander, Quicksilva, Silvasoft and Softek. So if these companies are failing to provide you with proper service you now have carte blanche to get on the phone to GOSH secretary Mike Johnston, 01-801 9172.

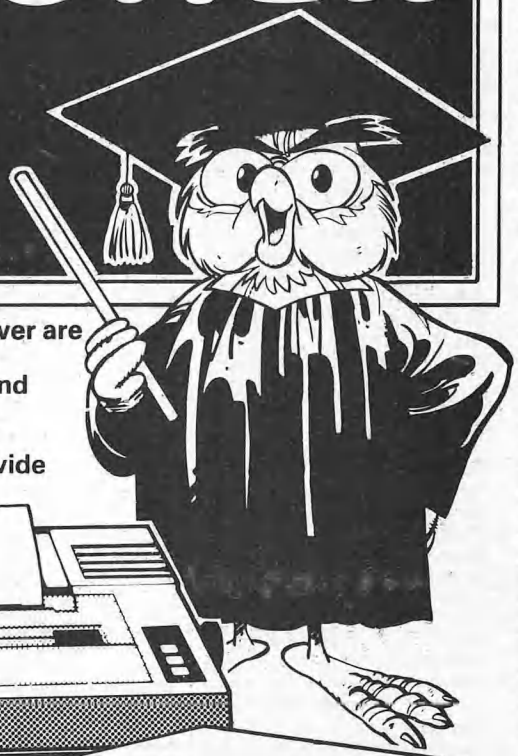
"We needed an organisation with teeth which means putting in a lot of money to run an office" commented Guild Chairman Nick Alexander. So members pay a hefty £500 on election to the Guild. If they blot their escutcheon they will be subject to the Guild Disciplinary Procedure involving fines, explusion and general casting into the outer darkness.

The Guild is really the brainchild of the Computer Traders Association, itself formed in September last year by companies like Atari, Tandy, Boots, John Menzies, Virgin and Silvasoft. "There are two aspects to software trading — political and legal" said Nigel Buckhurst of the CTA. "While we're very good on export advice and dealing with government departments, we felt it was wrong for CTA to get too involved in legal problems, which are also very expensive."

Hence the formation of the Guild. As time goes on, CTA plans to form other specialist sub-groups and is working on one dealing with business computers together with the Office Machine Equipment Federation.

More importantly CTA has plans to stop the selling of software in the U.K. altogether. This is a legal nicety — software will be licensed rather than sold, so it will never be the property of the end user. This would make life tough for tape libraries and software poachers. This could be almost as revolutionary as the clause in GOSH's customer guarantee that says members undertake to avoid advertising products as available before this is in fact the case.

MICRO POWER ARE TOP OF THE CLASS!



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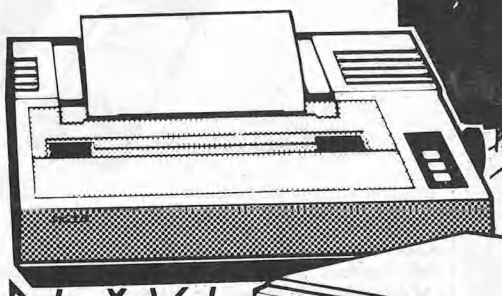

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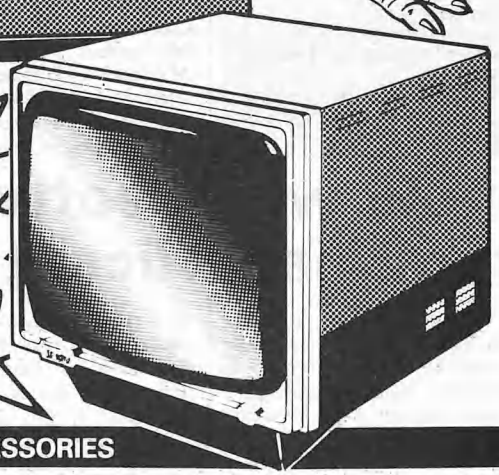

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I could do that...

Computers use quite a nice trick when they subtract one number from another: they simply switch all the bits in the number to be subtracted — 0 to 1, and 1 to 0, then add 1 — called the "two's complement" of the number. Then all that need be done is to add the resultant numbers. For example: in a 4-bit computer, taking 5 from 11 gives, in binary:

	1011
	- 0101
First — Invert 5	1010
Second — Add 1	1011
Now add	1011
	+ 1011
Gives	1 0110

The most significant bit will not fit in 4 bits — and the computer simply ignores it . . . so it is left with 0110 — 6 — the correct answer! Last month's puzzle dealt with addition — so those of you that did the puzzle will already have done half of this month's. We are looking for the best program to take two 16-bit numbers, in binary, and subtract the second from the first, giving the result in binary too. Next month: Multiplication.

July's competition to write a program which displayed the spread of random numbers proved easy enough for most entrants. The £15 prize goes to S Middleton, 57 Downs Valley Road, Woodingdean, Brighton, for the following program to run on a Dragon 32:

```
10 R=100:DIM F(R)
20 PMODE 4,1:PCLS 0:SCREEN
   1,1
30 FOR I=1 to 150*R
40 N=RND(R)
50 F(N)=F(N) + 1
60 PSET (28 + N*200/R,
   192 - F(N))
70 NEXT I
80 GOTO 80
```

BEGINNERS *first bytes*

Starting out in home computing? First Bytes is for you. Just write to *Your Computer* with any hardware or software problems, no matter how small or simple.

Machine code

"Not only do I not understand machine code but I find the business of typing in other people's machine code programs confusing. Could you explain what, for instance, a hex loader is and what it does?"

UNLESS YOU HAVE an assembler there are two problems with writing machine code on a home micro; that is, where to enter it and how to enter it.

These problems are highlighted on the ZX-81. So slow is the ZX-81's Basic that anyone wanting to write a fast-moving game is greatly encouraged to learn machine code, and perhaps more people have learnt Z80 code on this micro than on any other. Yet, at the same time, it is a particularly awkward micro on which to write machine code.

For a start where can you store the code? One possibility is to lower the top of the Basic program area, RAMtop, and house the code above it. But how can you save it there? Unlike other micros the ZX-81 has no facility for Saving a specified block of memory: you can only Save a Basic program.

The solution adopted by most programmers is to store the code within a Basic program in a Rem statement. It can be safely Poked into the line after the Rem since the Basic interpreter ignores any character after the Rem.

First you need to ensure that there are enough characters on the line to accomodate your machine code routine and also you need to find out where in memory the Rem begins — the start address of your machine code. If the Rem statement on the ZX-81 is the first program line the start address will be 16514.

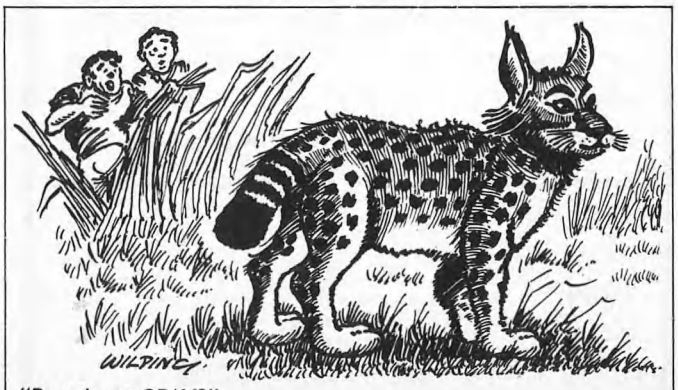
This rather cumbersome procedure is unnecessary on most other micros. Commands like the Spectrum's Save " " code and the Dragon's CSaveM allow you to Save a stretch section of code anywhere in memory, whether within a Basic program or not.

The other problem that often mystifies beginners is the business of entering code. It is probably easiest to insert the machine code instructions in Data statements, read them into a variable and then Poke them into the required section of memory.

The alternative is to input them directly from the keyboard and for this you will need a hexadecimal or decimal loader. A good loader should allow you to input numbers either one at a time or in string and then print out the number and the address to which it has been Poked.

In addition a hexadecimal loader will need to convert the hexadecimal input to decimal. This is because although most machine code programmers prefer to work in hexadecimal most home computers require a number to be in decimal before it can be Poked into memory.

You do not need to understand machine code to be able to use it in your own programs. Many short but effective routines have been published. Typically they are for scrolling the display or inverting the display. If you understand how and where to insert them you can easily pep up your Basic programs.



"Does it run CP/M?"

What does CP/M do?

"Can you define CP/M and explain its advantages?"

CP/M IS A SPECIAL type of program known as an operating system. It usually comes as a standard supplied software package with larger computer systems. Generally it runs on Z80 or 8080-based micros, though there are versions available to run on other processors. It also requires a certain amount of memory, usually 64K and at least one disc drive.

The Camputers Lynx will probably be the first cheap home computer capable of running CP/M, which will greatly increase its importance. But for it to be capable of doing so a user must add memory, in this case 128K of RAM is needed, and a disc-drive.

Nowadays CP/M is firmly established as the standard micro operating system, especially among business or serious users. Originally it was developed as a tool for hobbyists by Gary Kildall, a young

(continued on page 47)

CAMEL PRODUCTS

BLOPROM-81

```
STATUS )      NO. SYSTEM - HEX
       )      EPROM TYPE - 27128
       ) RAM START ADDR - 4000
       ) EPROM ST. ADDR - 0000
       )     JOB LENGTH - 4000
       )           TASK - CHECK
WHICH TASK DO YOU WISH TO DO

W) CHECK  THAT EPROM IS CLEAN

X) READ   THE CONTENTS OF
          EPROM INTO RAM
Y) BLOW   AN EPROM WITH DATA
          FROM RAM

Z) VERIFY THAT EPROM DATA IS
          THE SAME AS IN RAM

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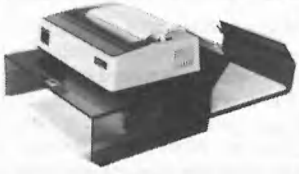

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(continued from page 45)
American computer fanatic who is now a multi-millionaire at the helm of Digital Research, one of the largest micro-software houses in the world.

What makes CP/M so wonderful is that it makes every computer look the same as far as software is concerned. In principle you should be able to load a disc from any CP/M computer into another and the software contained on the disc should load. In practice this does not often happen because different machines use different disc formats and have differing disc hardware.

Discs recorded in the IBM format tend to be the most common and they can usually be swapped between different CP/M machines. The larger machines usually have Basic on disc rather than in RAM, and this means that applications software, that is the programs that run on the machines, only have to be written for one CP/M machine.

It is a trivial matter to transport them to other CP/M machines provided they contain no instructions that make special use of a machines features.

Because CP/M is available on such a wide range of machines, there is a very wide choice of available software. Any manufacturer designing a new business micro will choose to run CP/M as this wide range of software makes his micro look all the more attractive to the buyer. A software manufacturer, on the other hand, will develop software for CP/M because so many people already have it.

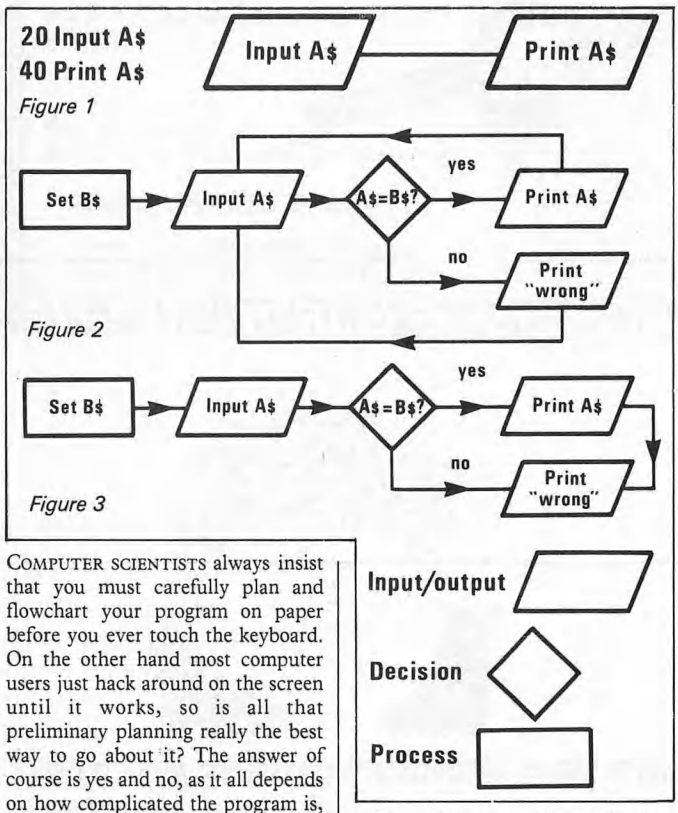
Digital Research has developed a similar product to CP/M which performs the same standardising task, but for graphics. It allows a programmer to develop graphic images on one machine, and will allow the same image to appear on another machine when fed with the same data.

It is unlikely that CP/M will appear on the Spectrum, although not impossible. The reason for this is that Sinclair Research has opted for a non-standard mass media, the Microdrive, and supports it with a number of built-in commands — the ones that appear on the keyboard but cannot yet be used.

Also as the Spectrum has only 48K, loading in CP/M and a relevant version of Basic would not leave much room for applications software.

BEGINNERS first bytes

Program flowcharts



COMPUTER SCIENTISTS always insist that you must carefully plan and flowchart your program on paper before you ever touch the keyboard. On the other hand most computer users just hack around on the screen until it works, so is all that preliminary planning really the best way to go about it? The answer of course is yes and no, as it all depends on how complicated the program is, and how experienced you are.

Without a doubt flowcharts are an excellent way of finding bugs in your programs but to make a start you need to understand the language. There are many symbols used in flowcharting but as far as most programs are concerned there are only three different situations and symbols to worry about.

Input/output describes entering responses from the keyboard or joysticks and sending output to the screen, sound channel or printer.

Process describes any part of the program which manipulates the information.

Decision points are usually the most important parts of the program as it is the arrangement of these which make the computer appear intelligent.

Figure 1 is a very simple flowchart of a routine to print a character on the screen.

Now add a process, a decision point, and an alternative program path.

```
10 LET B$="TEST"
30 IF A$<>B$ THEN 100
100 PRINT"WRONG"
```

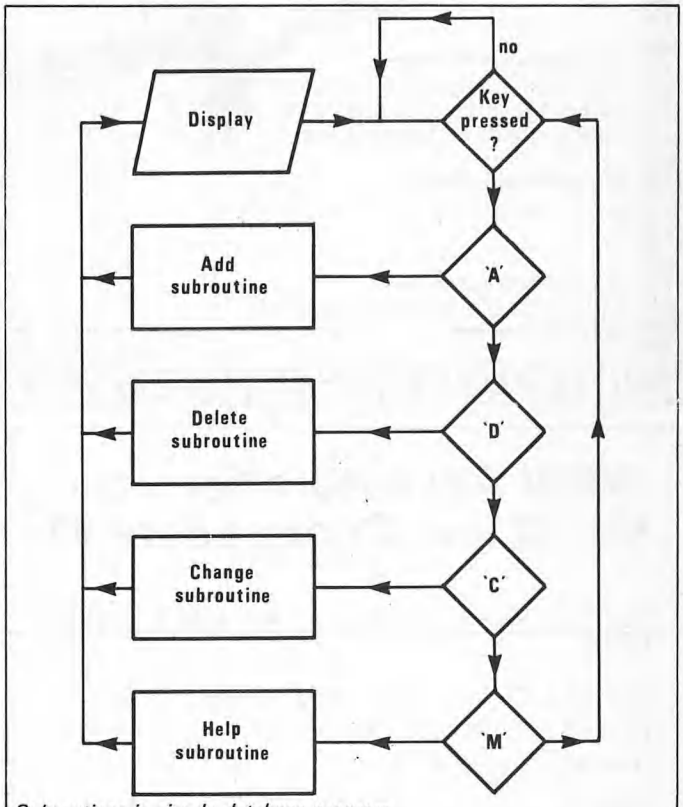
See Figure 2.

Of course that program does not do what you really wanted as even if you are right you are told you are wrong! What we need to add is a longstop which catches you when you are right, and why not automatically return for another input? There is no point going back to the start as B$ is still set.

```
50 GOTO 20
110 GOTO 20
```

See Figure 3.

Keith and Steven Brain



Subroutines in simple database program

Using subroutines

MOST VERSIONS OF Basic allow you to use subroutines, but when should you bother to use this programming method? The important thing about calling a subroutine with Gosub is that the program remembers where it was and Returns to that particular point. The parts of a program to put in a subroutine are really any groups of lines which are used several times.

There is not much point in putting a single instruction like

```
PRINT A$
```

as a subroutine, as you still have to put Gosub — line number — wherever you want to call it in the program. The more complicated your program and the more complex the contents of your subroutine, the more useful it is likely to be.

Arranging your program as a series of subroutines can make it easier to plan, and may also make it run faster. Frequently used subroutines should be put near the start of the program, as each time a Goto or Gosub is met the system searches for that line number from the start of the program.

Parts like instructions which are not needed frequently are often put at the end of a program and are only called at the start of a program, or if you need help. For example, a simple database program might consist of a help subroutine, three 'action' subroutines, and a keycheck routine which decides where the program should branch. See drawing above.

Keith and Steven Brain

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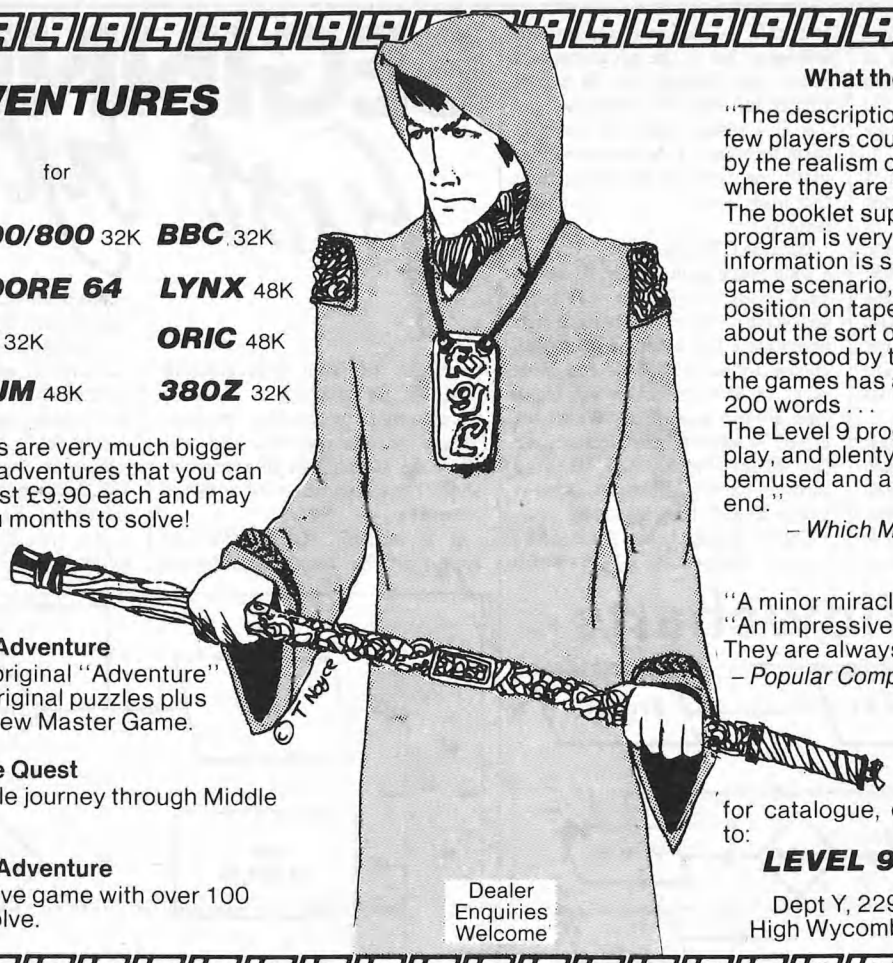

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Local news

Aylesbury
The Aylesbury ZX Computer Club was one of the first to stage a public demonstration of the new Sinclair Microdrive. Other equally exciting events are planned. For details phone Keith Pyott on 0296 63087.

Merseyside
Once a fortnight the Merseyside Commodore Users' Group congregates at Maghull Deyes High School, Deyes Lane, Maghull, Liverpool. Meetings start at 7.30. Contact Mr J P Jones on 051526 4813.

Manchester
Not only TRS-80s but also Dragons and the burgeoning new wave of Tandy computers are catered for on the last Wednesday of each month at Barton Aeroclub, Barton Aerodrome, Irlam, near Manchester. Telephone 0942 812843.

Southend
The Esplanade Hotel, Western Esplanade, Southend is the venue every Monday evening for the Southend Computer Society. Contract Robin Knight on 0702 21845.

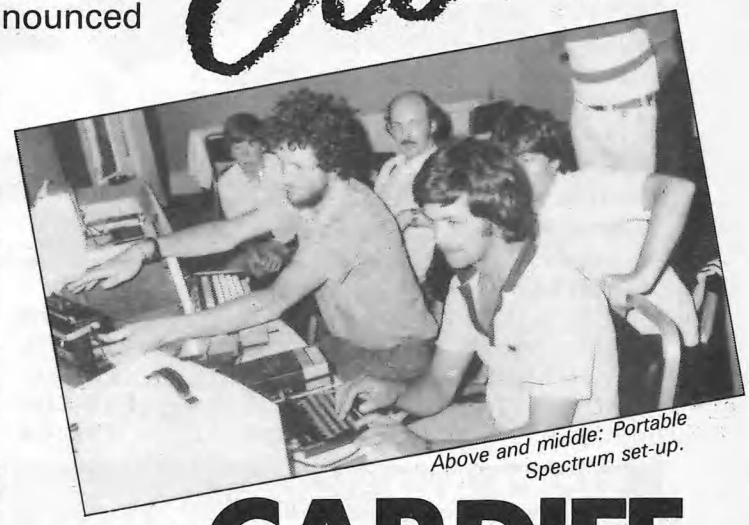
Chadderton
Every Thursday South Chadderton Computer Club meets at Turf Lane Centre, Turf Lane, Chadderton between 7 and 9.30. For more information: Mr Jakeman, 26 Marble Street, Oldham, Lancashire. Telephone 061678 0547.

Darlington
Darlington Computer Club normally meets weekly, but events are less regular during the summer. Technical library is provided. Contact Leslie Boxell, 8 Vane Terrace, Darlington DL3 7AT. Telephone: 0325 467766.

Southport
Tuesdays and Wednesdays weekly is when Southport Computer Club meets. Contact Ian Bristone, 28 Weld Road, Southport, Lancashire. Telephone: 0704 64524.

COMPUTER *Club*

Meirion Jones finds a welcome in the hillsides at Cardiff Computer Club where there is much excitement over Sinclair's recently announced Microdrive package.



Above and middle: Portable Spectrum set-up.

CARDIFF

TRADITIONAL WELSH dry Sundays have already been washed away in a tide of Brains Dark; Cardiff's local brew. Now choir practice and rugby training are under threat; this time home computers are leading the nation's youth astray.

On the last Sunday of every month up to 80 Sinclair enthusiasts turn up at the Central Hotel in Cardiff with their ZX-81s and Spectrums for the Cardiff ZX Club. There are now 120 members but back in November 1981 when the club started as The '81 club there were only two — Steve Smith and Mike Hayes.

The sudden growth of the club and perhaps over-exposure to adventure games has had strange effects on its founders. There is still no formal committee but Steve Smith says: "You can put me down as Emperor if you want".

Sinclair's Microdrive was the main topic of conversation at the meeting. Tim Gilberts who runs the Barry-based software house Gilsoft plans to write adventures that will take advantage of the 85K storage on each Microdrive cartridge.

David Bath who runs a small business in his spare time selling American science-fiction magazines is looking for more practical advantages. He originally bought a ZX-81 to help him with sorting out the orders. He soon moved on to a Spectrum and now finds that it takes two hours to organise which magazines go to which customers, compared with six hours when he did the magazine collation manually.

The Interface 1 will allow him to connect a printer to produce sticky labels, and with a Microdrive to store the information his whole task could be completed in minutes.

Below: Tim Gilberts demonstrates Gilsoft's adventrue writing Quill program.

Cardiff ZX Club runs machine-code tuition sessions but the afternoon I was there was too hot for work. There was a different game on each of the 20 TV screens dotted around the room. Of the commercial programs Bug-Byte's Manic Miner seemed the favourite, also going down very well was Duncan Kinnaird's *Star Wars* game from our July issue.

The ZXers split long programs such as our Flight Simulator in December or our Submarine Mission in August into as many as six sections each of which is entered by a different member of the club.

The oldest member of the club is probably Henry Morgan from Llanrumney. But many of the members are as young as 12. Although many at the Sunday meetings are still at primary school there is also a mid-month session which is held in a fortress-like public house in Canton apparently for the sole reason of keeping out under 18-year-olds.

There are 5,000 home computers in and around Cardiff most of which are Spectrums. If you own a Sinclair and want to join the ZX Club you can contact Mike Hayes on 0222-371731.

For BBC Micro owners there is also the Cardiff BBC Users which meets on alternate Wednesdays — August 31, September 14 and so on — at University College Cardiff Mechanical Engineering Department, Newport Road, Cardiff. Contact Geoff Barker on 0222-701023.

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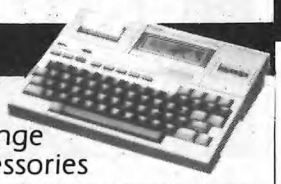

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Star chart

Maziacs
16/48K Spectrum: Novelty: £6.95: DK'tronics.

★★★

Blood-thirsty maziacs make your return trip to the adventurer's gold as uncomfortable as possible. For a successful outing you need plenty of swords, food and sound advice from the maze's hapless prisoners. Exciting, but luck often plays too large a role.

Orc Attack
Atari 400/800/1200: Novelty: £29.95: Thorn EMI Video.

★★

You defend your castle against hordes of orcs trying to scale the wall, fending them off with swords, rocks and boiling oil. They fight back with daggers and, if you are unlucky enough to be caught in the path of one, your head is severed. If you kill the orcs before they kill you the Sorcerer's spirits attack. If you survive that you have to slay the Stone Warts. I'd sell the castle. Good graphics and animation.

Vic Rescue
Vic-20 unexpanded: Shoot-'em-up: £5: Interceptor Micros.

★

The aim of the game is to release a rescue pod from the mothership and get the humans off-world having weaved through the asteroid belt. The graphics are unexciting and in space no-one can hear you scream. This explains why the only sound in this game is the noise of your spaceship crashing into an asteroid.

Star Jammer
Dragon 32: Shoot-'em-up: £7.95.

★★

In Star Jammer you manoeuvre your ship by joystick in order to get an alien ship in your signts, then shoot it down using your laser. Stargates are triggered automatically by beacons on your ship as you approach. Graphics are workmanlike and it is certainly tricky to keep the attackers in your sights.

SOFTWARE Shortlist

Terrordactyl
- *48K Spectrum*
- *£6.95*
- *Melbourne House*

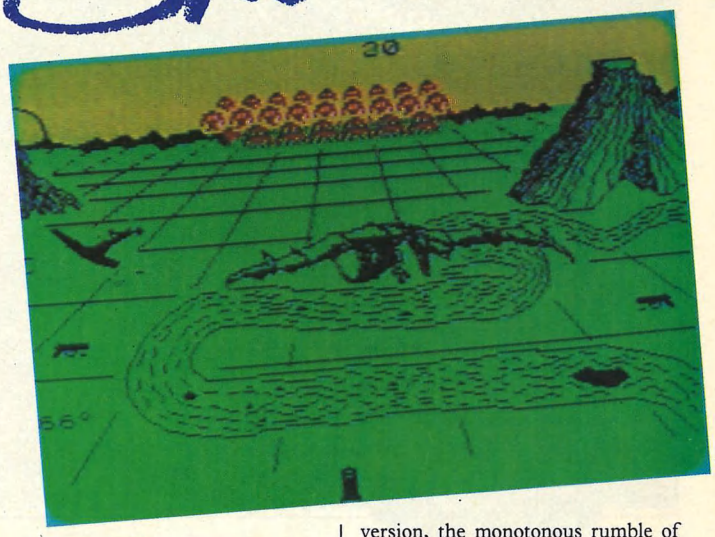
★★

SOME YEARS AGO Terry Dactyl and the Dinosaurs made their one mark on the pop charts. Unfortunately the tune was so much like Mungo Jerry's *In the Summertime* that now only Keith can still remember it was called *Seaside Shuffle.* Terrordactyl is likewise doomed because of its similarity to Space Invaders.

There is nothing wrong with the 30 graphics or with the setting. You are on a flight of Lost Jungle Airlines which crashes leaving you staring across a plain with a smouldering volcano on your right. You are armed with a tank-style gun which you fire at waves of invaders that come over the horizon and get bigger as they move towards you. Every so often a very life-like Pterodactyl comes screeching towards you and you must avoid it or kill it first time. If you can survive you are treated to a glorious sunset and sunrise and you go on to Day 2, Day 3, and so on.

But the game soon becomes tiresome, which is a shame because dinosaur mania has been sweeping the country since July when a 200 million-year old meat-eating fossil called Claws was discovered in a Croydon clay pit.

Claws may have been the most exicting thing ever to come out of Croydon but Terrordactyl is certainly not the most original program to come out of Melbourne House.

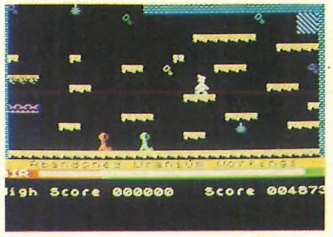


Manic Miner
- *8K Spectrum*
- *Bug-Byte*

★★★★

MINER WILLY stumbles on the riches of a lost civilisation while prospecting in Surbiton. Your job is to guide him back to the surface avoiding poisonous pansies, spiders and slime, and worst of all, the manic mining robots. Willy must also collect the keys which are vital to his escape to each of 20 lethal levels.

The game has excellent graphics, and keyboard control gives you plenty of choice as to which keys are most convenient for you to use. There is lots of wacky humour, too from the penguins in the cold room to the ferocious toilet seats in Eugene's lair, a witty side-swipe, no doubt, at one of Imagine's star programmers. Satire on other games also creeps in — Pac-Man lookalikes are to the fore in the processing plant and there is a Kong Beast and a



Return of the alien Kong Beast. Not to forget the Attack of the Mutant Telephones — do not ring us we will ring you, eh, Llamasoft's Jeff Minter?

Games like this certainly make the averge micro user of the paucity of imagination that less dynamic software houses are stricken with. What is the point of buying one game if so many elements of different arcade games can be so effectively combined? The animation is excellent. With games like this Bug-Byte will be laughing all the way to the bank — which occurs, in Manic Miner, on the 15th screen.

Submarine Commander
- *Vic-20*
- *£24.95 cartridge*
- *Thorn EMI Video Ltd*

★★

FULL FATHOM FIVE thy father lies; of his bones are coral made: those are pearls that were his eyes. Yes, Dad's been at the Vic-20 submarine patrol simulator again, and, let's face it destroying all enemy merchant shipping in Mediterranean waters has never been an easy number.

This is a competent implementation of Submarine Commander, but lacks, in comparison with the Atari version, the monotonous rumble of engines throughout the mission and the colourful map. There are two main display screens; one shows a map of the Med with ships moving about, which you have to steer towards using the compass; and the other gives you a view through the periscope. You can also call up a sonar display when submerged, with a realistic pinging sound.

As you close in on the convoy they will start to bombard you — the screen shakes convincingly — and be careful not to get too close to the sea floor on the coastline, as this does not help your promotion prospects. Diving is also risky because too great a depth will fracture the hull causing wet feet all round. It is worth keeping your weatherbeaten old seadog's eye on the oxygen level, fuel, battery charge — most of you will be aware by now that diesel submarines run on batteries when submerged, and that the batteries are charged by diesel engines when snorkelling or running on the surface.

Submarine Commander has nine game variations, but not really enough new surprises occur to lift this one out of the merely good category. The occasional air attack would have been nice, for example. But the game is well thought-out: it is up to you to decide if it is worthwhile buying just another game at this sort of price, when you could more profitably buy a new peripheral — or maybe even another micro!

Sinclair's Microdrive promises fast mass storage at a price you can afford. Kathleen Peel finds out if this is the tape of things to come.

```
cat saved
kathy

cat
i/f
i/f2
i/f3
shell
yc1
yc2
yc3
zzzzzzzzzz

37
i/f        3 3
i/f2       4 4
i/f3       5 5
shell      6 6
yc1        7 7
yc2        8 8
yc3        9 9

done

zzzzzzzzzz10 10

zxc erased

cat erased
kathy

i/f
i/f2
i/f3
shell
yc1
yc2
yc3

38
stop
```

```
  1 REM AUTO FILE HANDLING SHELL
  5 SAVE *"m";1;"zzzzzzzzzz"
  7 LPRINT "zxc created"
 10 OPEN #5;"m";1;"cat"
 20 CAT #5;1
 30 CLOSE #5
 35 LPRINT "cat saved"
 40 CLS : CAT #3;1
 45 LET c=0
 50 OPEN #6;"m";1;"cat"
 60 FOR n=1 TO 51: INPUT #6;x$
 65 LET c=c+1
 67 IF c<3 THEN  NEXT n
 70 IF x$="zzzzzzzzzz" THEN  GO TO 100
 80 LPRINT x$,c;" ";n
 90 NEXT n
100 CLOSE #6
220 LPRINT : LPRINT "done": LPRINT : LP
RINT x$,c;" ";n
225 ERASE "m";1;"zzzzzzzzzz"
227 LPRINT : LPRINT "zxc erased"
230 ERASE "m";1;"cat"
235 LPRINT : LPRINT "cat erased"
240 CLS : CAT 1
245 CAT #3;1: LPRINT "stop": LPRINT
250 STOP
```

```
  1 GO SUB 9990: LET y=40: RESTORE
  2 DATA "
 96 LET z=0
 97 INPUT "print to screen y/n ";z$: IF
z$="y" THEN  LET z=1: LET y=32: GO TO 1
01
101 LET d=0
102 READ a$: IF y=32 THEN  GO TO 106
103 IF a$(1)="@" THEN  LET a$=a$(2 TO )
: GO SUB 9980: GO SUB 9960: GO SUB 9990:
GO TO 102
104 IF a$(1)="&" THEN  LET a$=a$(2 TO )
: GO SUB 9980: GO SUB 9950: GO SUB 9990:
GO TO 102
105 IF a$(1)="z" THEN  LET a$=a$(2 TO )
: GO SUB 9980: GO SUB 9970: GO SUB 9990:
GO TO 102
106 IF LEN a$>y THEN  GO TO 120
110 IF z=1 THEN  PRINT a$: GO TO 112
111 LPRINT a$
112 GO SUB 180
115 GO TO 102
```

```
120 LET c=0
125 IF c=y THEN  GO TO 150
130 LET b$=a$(y-c)
135 IF a$(y+1-c)=" " OR b$=")" OR b$=",
" OR b$="." OR b$=":" OR b$=";" OR b$="?
" OR b$=CHR$ 34 THEN  GO TO 155
140 LET c=c+1
145 GO TO 125
150 LET c=0
155 LET c$=a$( TO y-c)
156 LET a$=a$(y+1-c TO )
157 IF a$(1)=" " THEN  LET a$=a$(2 TO )
160 GO SUB 200
165 GO SUB 180
170 GO TO 106
180 LET d=d+1
185 IF d<22 THEN  RETURN
190 PAUSE 500: REM  IF z=1 THEN  COPY
192 CLS : LET d=0: RETURN
200 LET g$=" "
205 FOR f=LEN c$ TO 1 STEP -1
210 IF LEN c$>y-1 THEN  GO TO 240
215 IF c$(f)=" " THEN  GO TO 220
216 NEXT f
218 GO TO 205
220 LET c$=c$( TO f-1)+g$+c$(f TO )
221 LET f=f-1
225 LET c=c-1: IF c<=0 THEN  GO TO 240
230 GO TO 216
240 IF z=1 THEN  PRINT c$: RETURN
242 LPRINT c$: RETURN
999 REM  TIDY PROGRAM
1000 DATA "": REM Enter files to be dele
ted here, then RUN1000
1001 DATA "zxc"
1002 RESTORE 1000
1003 READ a$: IF a$="zxc" THEN  CAT #3,1
: STOP
1004 ERASE "m";1;a$
1005 GO TO 1003
9950 LPRINT CHR$ (18): LPRINT "S0": LPRI
NT CHR$ (17): LET y=80: RETURN : REM set
 80 chars
9960 LPRINT CHR$ (18): LPRINT "S1": LPRI
NT CHR$ (17): LET y=40: RETURN : REM set
 40 chars
9970 LPRINT CHR$ (17);CHR$ (29): RETURN
: REM change colour
9980 CLOSE #3
9981 FORMAT "b";600
9982 OPEN #3;"b"
9984 RETURN
9990 CLOSE #3
9991 FORMAT "t";600
9992 OPEN #3;"t"
9995 RETURN
```

Program 1.

```
10 DATA '': REM Files for deletion
20 DATA 'zxc'
30 RESTORE
40 READ a$: IF a$='zxc' THEN GOTO 70
50 ERASE 'm';l;a$
60 GO TO 40
70 CAT #3;1: STOP
```

Program 2.

```
10 LET a$='kate'
20 IET d=49
30 LEt b$=a$: LET a$=a$+CHR$ (d)
40 SAVE *'m';1;a$
50 LET a$=b$
60 LEt d=d+1
70 IF d=110 THEN CAT #3;1: STOP
80 GO TO 30
```

SIXTEEN MONTHS after they were announced the first Microdrives are just being delivered. The price is still £50 for a drive which takes 85K tape cartridges instead of the 100K originally promised, but you can find and load a program in a few seconds. You will also need the Interface 1 before you can plug in up to eight Microdrives, but this interface gives you RS-232 and local area networks.

The Microdrive is housed in a box 90 by 85 by 40mm in size with an aperture at the front for loading the cartridge, and printed circuit board edge connections on both sides towards the rear. The right hand connector plugs via a flexible cable to the interface unit, if it is Microdrive 1 or plugs directly through a double ended socket to the next Microdrive. The drives are secured to each other by a plate underneath the housings. This should prevent the dreaded wobbles.

There are two small printed circuit boards inside which are without modification. The lower board provides the two edge connections, while the central vertical board houses a ROM and the tape head, which is used for both record and erase functions.

The mechanism is uncomplicated. The drive is generated by a rubber roller mounted directly on the end of the motor spindle. Pressure is applied by a leaf spring on the opposite side of the cartridge. The spring also maintains the cartridge position relative to the head, a very simple and highly efficient set up. My only worry would be head wear due to the abrasive action of the tape.

When the Microdrive is running, an LED indicator is lit. A warning is given not to remove the cartridge while this light is on.

The cartridge is claimed to be able to handle up to 50 files and have a minimum storage capacity of 85K. The two spare cartridges supplied for the review both had 90K of storage space available when formatted.

Typical access was very fast in comparison with cassettes but, human nature being what it is, you tend to notice when it is slower than usual. It can take longer to type in the load command than to find and load a short file.

The storage media is an endless loop of tape. The cartridge is very small 45 by 35 by 7mm., including cover and makes the opposition's 75mm. floppies seem huge in comparison. The cartridge can be write-protected in a similar manner to cassettes by removing a plastic tab, a piece of sticky tape will re-enable write.

I assume that before long we will be able to purchase S100 and S200's — Sinclair 200K — cartridges. In some applications it is quantity of storage rather than speed of access that is important. It will also be necessary to store the cartridges in a holder similar to those available for cassettes. The Sinclair hardware add-on industry is in business again.

Sinclair only supplies one blank cartridge per Microdrive, further cartridges are supplied singly with an order form for repeat purchases. Bearing in mind Sinclair's advice on the need for back up copies, it just is not sufficient.

It is possible to use strings for filenames in the Microdrive commands and variables for the Microdrive number. Because of the initial high cost of the cartridges, it makes sense to

produce the tidy facility shown in Program 1.

Program 2 was used to test the file storage capacity of 50 files. Three points emerged from the tests:

- Each file appears to occupy a minimum block of 512 bytes.
- As the limit of 50 files is exceeded, file names disappear from the catalogue in an apparently random fashion, but they still occupy space on the cartridge and are still loadable.
- The average time taken to Save a short file in this manner is 10 seconds.

An attached Microdrive has no effect on the vast majority of commercial software. Only in one case where a program used interrupt control was a program found not to work, and I am not sure why not. If you open a stream to the Microdrive or Net then problems will arise, but if you do not try to use the Microdrive or try to Network a program then it should make no difference whatsoever.

The user is warned not to remove a cartridge while the Microdrive's LED is lit and not to switch on or off with a cartridge in the drive. This I continually forgot with no apparent mishaps to the stored data.

I think the user would be wise not to leave a cartridge in the drive for long periods of storage, the pressure roller may take a permanent set and upset the tape transport.

I would have liked a protective flap over the cartridge entrace, not all drives will be used in a clean environment.

The ZX Interface 1 was also announced in April 1982. It was simply called the RS-232/Network interface board and was expected to sell for £20. Since then it has been expanded and now serves three functions:

- Microdrive controller
- RS-232 interface
- Local-area network

This little box of goodies is something special. There are flaws but it is still a very powerful addition to the Sinclair range of computer peripherals.

Surprisingly the two printed circuit boards in the Microdrive show no signs of modification whereas the printed circuit board in the interface has been altered. The board contains two integrated circuits, a prototype Ferranti LSI and an EPROM.

A Sinclair spokesperson has stated that the equipment delivered to customers will, in fact, contain proper production devices.

The interface plugs into the Spectrum rear connector and is attached through two existing screw holes to the underside of the Spectrum, the original screws may be discarded. A duplicate rear connector port is available on the interface as are the two 3.5mm. network sockets and the nine-pin d-shell connector for

(continued on page 55)

TANK BATTLE
Enemy tanks invade your position! Manoeuvre your tank controlling its gun barrel for accurate range. WATCH your salvos disintegrate the enemy BUT BEWARE the accurate return fire. Realistic graphics and sound. 5 levels – strategy to desperation.

HOUSE OF BUGS
The Bugs in this game will raise the blood pressure to the limits and drive spectators into a FRENZY! KILLER BUGS roam the top floors. Escape by clinging to the ceiling. You damage the plaster and need high scores to make repairs. Excellent graphics and sound.

LAS VEGAS
FRUIT MACHINE – Replica of a fruit machine – watch the symbols spin – nudge, gamble – WIN or LOSE – true percentage payouts. BLACK JACK – Break the bank with a five card trick. The Spectrum croupier is FAST and wants your stake money. Superb graphics.

BARON
Could you accept responsibility of a Barony? Farm your lands, maintain workers, hire mercenaries, wage FEUDAL WARS? Yearly analysis of success or failure of your decisions. Game of strategy for up to four players. Graphics.

DUNGEONS OF DOOM
Two challenging adventure games – to SEEK or ESCAPE. Graphics show your position – status reports – different layout with each new game. 4 players can search different levels and race for SUCCESS or SURVIVAL.

COBUS MAZE
If the MINES do not get you, then the COBUS WILL! 8 mind-stretching mazes – new layouts – progressive difficulty – ZOG the cobus and take a breather, BUT NOT FOR LONG . . .

MONOPOLY
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CHALLENGE
HIGHER AND LOWER – Skill, hunches and sixth sense are needed to beat this FAST DEALING MACHINE.
MASTERMIND – Play the MICROMIND with all the features of the well known game.

GODZILLA & THE MARTIANS
Leap over deadly martian invaders – scale ladders – jump the mantraps – rescue the Girl of your Dreams – oxygen pollution and time limit – for SUPERHUMANS ONLY

ADMIRAL GRAF SPEE
An original game of strategy based on factual records of the Graf Spee's formidable presence in the Atlantic. As her Captain use full graphic instrumentation to calculate speed, compass bearings, fuel, distance, ammunition states. LOCATE and manoeuvre into visual range and destroy enemy ships which can also evade. SEEK and DESTROY you!

SPECIAL MISSION
TOP SECRET – save the world from destruction. TIME is running out. . . HOW? . . . WHY? . . . WHEN? . . . Will you live to complete the adventure?

ADMIRAL GRAF SPEE by Simon Mansfield. Machine: ZX81 16K/ Spectrum 48K

GODZILLA & THE MARTIANS by Neil Streeter. Machine: ZX/ Spectrum 16K/48K

SPECIAL MISSION by Tony Frampton. Machine: TI99/4A- extended basic

MONOPOLY by Simon Lacey & Richard Fry. Machine: Dragon 32K/VIC 20+16K

DUNGEONS OF DOOM by Simon Mansfield. Machine: ZX81/16K/ Spectrum 48K

COBUS MAZE by Dave Gibson. Machine: VIC20 unexpanded joystick or keyboard

TANK BATTLE by Tony Frampton. Machine: TI99/ 4A-extended basic

BARON by Simon Mansfield. Machine: ZX81 16K/Spectrum 48K

HOUSE OF BUGS by Tony Frampton. Machine: TI99/ 4A-extended basic

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(continued from page 53)
the RS-232 printer/peripheral interface.

The Microdrive plugs into the exposed printed circuit board edge connector at the side through a flexible cable. The whole assembly is rigid and now the keyboard has been tilted, feels much easier to use.

The interface unit acting as the Microdrive controller, expands Sinclair Basic to include elementary file handling and communications commands. These are listed in Table 2.

The commands are created by paging the new ROM which creates an additional set of system variables. It looks from an cursory glance, that it is possible to re-vector the input-output routines used in both the Microdrive and Network channels.

The commands become a bit of a chore to handle after a while and you are soon driven to looking at producing your own simple operating systems.

Program 1 — tidy — is useful in containing the very rapid growth of a user catalogue. Program 3 — shell — is a means of handling the entire catalogue without coming up with the End Of File message and having unclosed streams and files.

Line 80 can be changed to provide whatever function the user wishes to apply to the catalogue. The printer outputs are not essential, they are there purely to aid fault finding.

The RS232 interface, which operates over a range of 50 to 19.2K baud with no parity, 8-bit character and two stop bits, should cover just about all but split-speed operation. There are two modes of operation.

The t channel is normally used for listings. the control codes are not sent except for 13 — carriage return — and the token codes are expanded. There is no graphic capability. These characters are replaced by code 63 (?).

The b channel sends the full 8-bit code and is used to send control codes to printers etc. Program 4 was written in order to produce this review and demonstrate the use of these channels. The Tandy four-colour printer has been used as the remote end of the RS232 interface, control codes are used to change to graphic and text modes, change pen colours and print size.

I can not recall ever having said that something from Sinclair was expensive, but £15 for an interface lead is a bit steep.

The ZX Net — local area network — promises to be a very powerful tool. The network is set up by simply joining two Spectrum interfaces together with the 10ft. long net lead. The manual reveals a network operating at 100K baud with handshaking between two attached devices. Up to 64 Spectrums can go on the net.

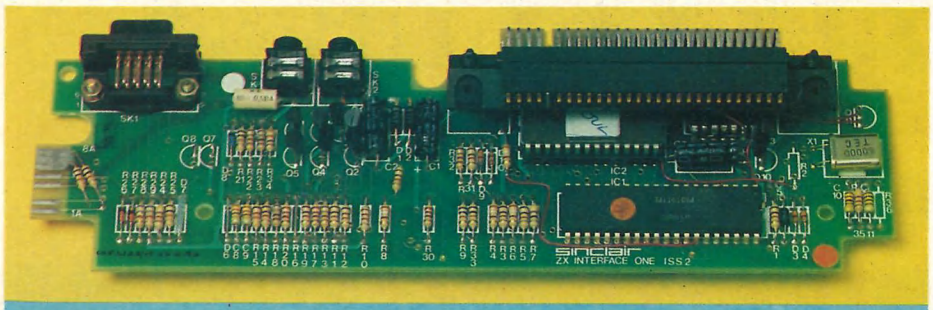
Print station facility

There is also a broadcast facility to download information to anybody listening on the net. This would permit a teacher to broadcast a program to the whole class at once.

Other uses include the ability to set up a print station to service all the Spectrums on the net. Perhaps when Sinclair has managed to clone a few interfaces these properties can be evaluated.

The manual falls short of the usual high Sinclair standard due, in part, to the fact that it is not a derivative of an earlier work. Everything appears to be there but I think some of the text needs presenting in a much simplier form.

The demo tape contains a print server program, untested, and a poor-man's Horizons tape-a-data base-program which provides the meaning of the Microdrive commands from a database at what can only be described as slow, I was not impressed. ■



CONCLUSIONS

- The drives possess slightly less storage than hoped, they cost slightly more and they are slower than expected. Nonetheless another outstanding Sinclair buy.
- The interface is a real gem. I know of some professional systems that could not match its performance.
- Together the devices have worked without any problems throughout the review period, a very good sign.

Table 1: Microdrive command format

LOAD* "M";1;"NAME"	The * indicates load from a microdrive
SAVE*"M";1;"NAME" LINE 10	Set name to run for autorun starup Line optional
VERIFY*"M";1;"NAME"	
MERGE*"M";1;"NAME"	Will not merge programs saved with a line number
ERASE"M";1;"NAME"	
FORMAT"M";1;"TITLE"	Title refers to a header for the cartridge

Table 2: Extended Basic commands

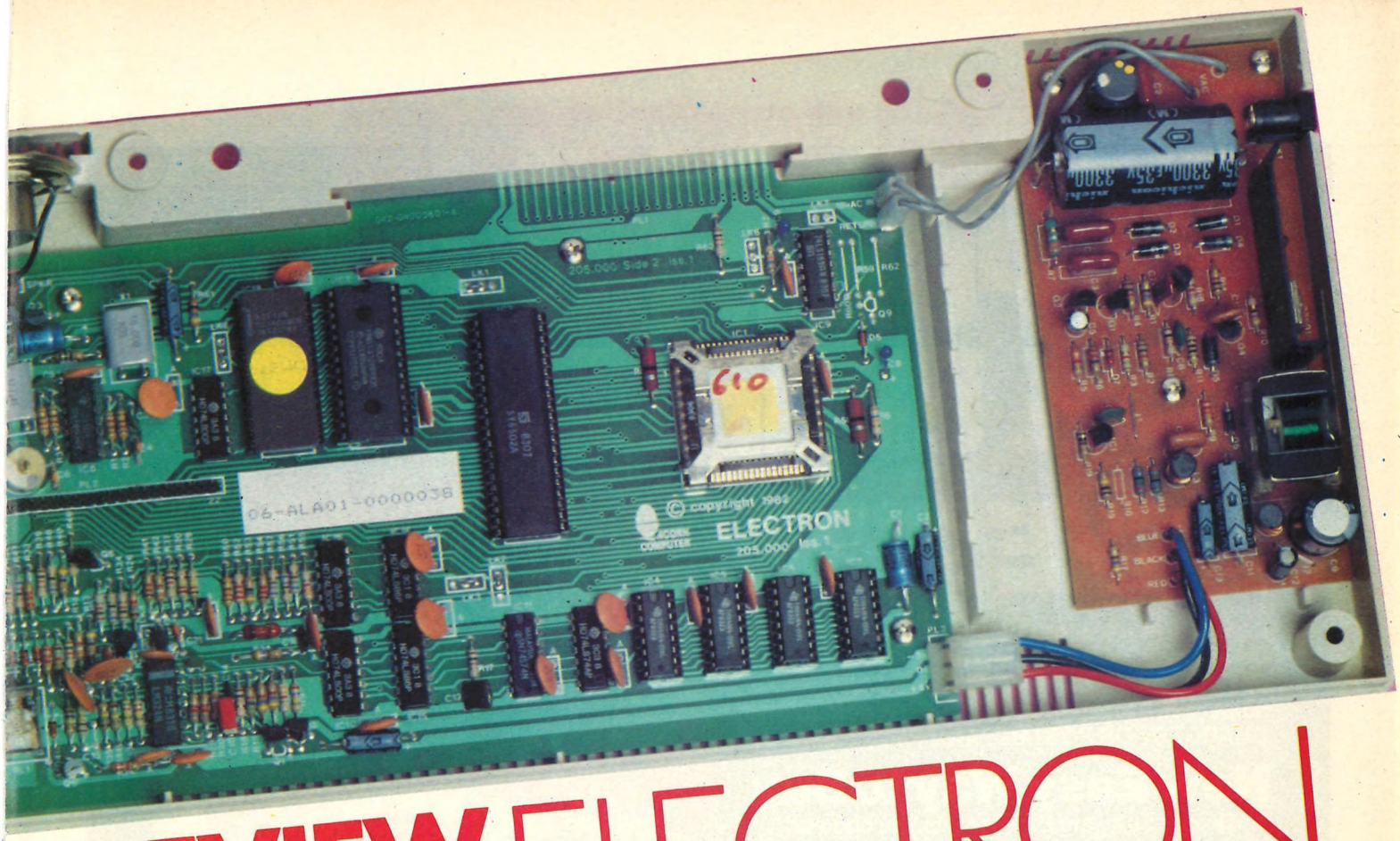
* Specifies a Microdrive function

CAT Y	Y is Microdrive number 1 to 8
CAT #Z;Y	Z is stream number 0 to 15
CLOSE# Z	
ERASE"M";Y;"NAME"	NAME is a file name
FORMAT"M";Y;" TITLE"	TITLE is a name for the cartridge
FORMAT"N";X	N means Network and X station No. 0 to 64
FORMAT"T";S	T indicates RS232 text and S is the baud rate
FORMAT"B";S	B is for RS232 binary data
INKEY$ #Z	Return a characteer or null
INPUT #Z;Vat	Inputs a variable
LOAD * CHAN	Load prog, data or file from B M or N channel, all other load options apply
MERGE * CHAN	
MOVE from TO dest	Only moves data
OPEN#Z;CHAN	Links stream to channel
PRINT #Z	Outputs to specified stream
SAVE *;CHAN	Saves prog,data or code to B M or N channel only
VERIFY *;CHAN	

Channels: data can be sent to various devices, your screen, ZX printer, microdrive file, another Spectrum on the same network and the RS232 interface. Data can be received from the following devices, the keyboard, a microdrive file, another Spectrum on the same network and the RS232 interface. These devices are known as channels

Streams: the routine from one channel to another is called a stream, there are sixteen streams in the Spectrum system.

Dr. Neil Cryer looks at the Beeb's baby brother — the Electron micro from Acorn.



REVIEW ELECTRON

THE ELECTRON could not be made much smaller, yet still have a full-size keyboard. It feels solid: no flexing of the case, however hard you try.

It is light, yet feels as though it would stand up to very rough treatment. Also there are no holes for kids to poke things in; so it should go down well with schools. Although the Electron, at £199, is half the price of the BBC Micro it has a better keyboard.

The Electron comes complete with an ultra-large plug which houses the power supply. A thin, very long flexible lead connects it to a small socket on the right-hand side of the case. I find that I have to keep taking the knots out of this lead but there are no signs of trouble, after two months hard pounding. When you switch on the Electron makes a little beep which is reminiscent of the Beeb, but quieter, and a green light appears to the left of the keyboard.

On many occasions I have left the Electron on all day. Even in the tropical heat which we have been suffering recently, the power supply stayed quite cool. The Electron does get warm underneath but not hot.

The Electron plugs in to a normal television or to a colour or black and white monitor. Three suitable sockets are supplied on the left of the keyboard.

The cassette connection is via a 7 pin DIN socket to the left of the keyboard. The signals here are at the same levels and with the same connections as for the BBC Micro. This means that any cassette recorder set up for the Beeb will plug straight into the Electron and load with no problems. The motor on the tape recorder can be controlled from the Electron, just as with the BBC.

When plugged in, the Electron produces the welcoming message on the screen:

Acorn Electron
BASIC

There is also a little symbol of an acorn at the end of the first line. Then the Electron sits waiting for your words of wisdom, either via the keyboard or the cassette connector — also on the left.

The Basic on the Electron is debugged BBC Basic. It is particularly noteworthy in that it positively encourages clear, structured programming. You will find it quite effortless to remove Gotos from programs and replace with such things as Repeat — Until loops, For — Next loops and procedures. Thus, the long variable names and the multi-line procedures and functions mean that your programs should soon become super-clear. You should find that you — and even other people — will be able to understand how your programs work, even months later.

Comprehensive user guide

The Electron comes with a readable and comprehensive user guide. It is well written but would benefit from an index. Also provided is an introductory cassette — which holds a number of demonstrations and games, together with a language called turtle graphics. This language is used extensively in another handout with the Electron: a short book entitled *Start Programming with the Electron.*

Entering programs for the Electron is particualrly simple for one-finger typists. The tops of the keys are marked with the usual typewriter symbols. However, on the fronts of the keys, you see, clearly printed, a whole set of Basic words such as For on the F key and Next on the N key. If you put one finger on the function key and then press one of these keys, you get whatever Basic word is printed on its side. This special feature is called single-key entry. For most people, it will save a lot of time and typing errors and will clearly be a boon. Touch typists will probably prefer to type everything out in full, which is also allowed.

As an example of single-key entry, suppose you press the Func key together with the D key. You get the message Draw on the screen as part of the current program line or instruction. You can add to this by typing on the keyboard or, indeed, you could erase all or just part of it by pressing the Delete key, if you so desired.

The number keys double as user definable function keys. So, if you would prefer some other message to appear on the screen as a result of a single key entry, then you can program one of the number keys to cause this. Any of the number keys can be defined to do a variety of things. For example, a single key press could be made to enter the instructions Renumber and List one after the other. Some people using the Beeb, which has similar keys, have entered whole programs as a key definition. This can be particularly useful for editing with the various programs which have been published for such purposes. The number keys still give the numbers if pressed without the function key.

The screen display for the Electron is exactly as for the BBC Model B, with the exception that mode 7, the teletext mode, is

(continued on page 59)

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(continued from page 57)

not available. The Electron starts up in mode 6 with 25 lines of 40 characters to one screeen. There are seven screen modes, numbered from 0 to 6, giving you from 20 to 80 characters per line, with either 25 or 32 lines per screen. Most of these modes allow mixed graphics and text in a number of colours. This is just the same as for the BBC Model B with from 2 to 16 colours, 8 steady hues and 8 flashing. The compromise between resolution and number of colours is the same as with the BBC Model B with mode 0 giving a resolution of 640 pixels by 256 in two colours while mode 2 gives 160 by 256 pixels in the 16 colours.

If you are not content with the standard character set of ASCII characters you can always define your own. By printing one character in one colour in the same place as another, you can also get multicoloured characters. Schemes for doing this for the Beeb have been published and they will work in exactly the same way for the Electron.

The Electron is slower than the Beeb — about 2/3rd the speed. There is no doubt that this must be a disappointment to the games software writers. Within the speed limitation, though, most games for the Beeb should still work on the Electron, provided they don't use mode 7 and don't try to scroll the screen sideways.

The Electron uses a massive ULA to do almost everything. This includes doing all that the 6845 video chip did in the Beeb. A impressive design this, going much the way Sir Sinclair did with his ZX breed. There is no screen blanking while loading from cassette, just a message giving the current block number being loaded and the program name.

You will see from the photograph of the inside of the Electron that there are very few chips. The main one which catches the eye is of course the ULA. There are 64 connections round this chip. When you think that the majority of the functions of the Beeb are also performed by the Electron you realise also that the masses of chips inside the Beeb have been replaced by this one ULA.

The sound on the Electron only allows one channel at a time. This is disappointing and means that you cannot produce BBC-style music. You can program the envelope of a note in terms of how the frequency should vary while the note is sounding. It is a pity that you cannot also program the amplitude as with the Beeb. Although you can still get most of the usual laser gun and other games effects, you will not be able to produce the Beeb's imitations of various musical instruments.

The sound is produced on one of three tone channels with a fourth for noise. Each channel has been arranged with a different priority. A note on channel 1 will cut off a note already sounding on channel 2, whereas a note on channel 2 will have to wait for any sounding on channel 1.

Basic programs load into memory at address E00, just as for the Beeb, and the memory map for the Electron looks very similar to that of the Beeb. All the relevant VDU, *FX and machine code call points are implemented as for the Beeb. By relevant I mean that some of the specialised VDU options for the BBC Micro, which addressed the 6845 chip, cannot work on the Electron as the ULA now replaces the 6845. The codes for turning on and off the printer are a little superfluous without a printer connection, but when a printer expansion is added, then presumably these will work normally.

This brings me to the assembler. The Basic includes a 6502 assembler, allowing all 6502 op codes and addressing modes, and it can be addressed from within a Basic program, just as for the Beeb. This now includes the use of Equs for storing strings directly in memory, Equb, Equw and Equd for byte, word and double word storage — 4 bytes at a time. These are a very welcome addition for assembly language programmers and make such programming very much simpler. Macros will still have to be implemented via functions or procedures as described elsewhere in the literature for the Beeb.

Now for the features that the unexpanded Electron does not have. These include sideways ROMs; so software such as View, Beebcalc and Beebpen will not work unless you are willing to unplug the Basic ROM and plug in the other ROM instead — which does seem to work. Even this will probably not be possible in the future, as the Basic and operating system chips sit on a little daughter board plugged into one socket. It would seem fairly clear that the intention is to replace the daughter board eventually by one 32K ROM.

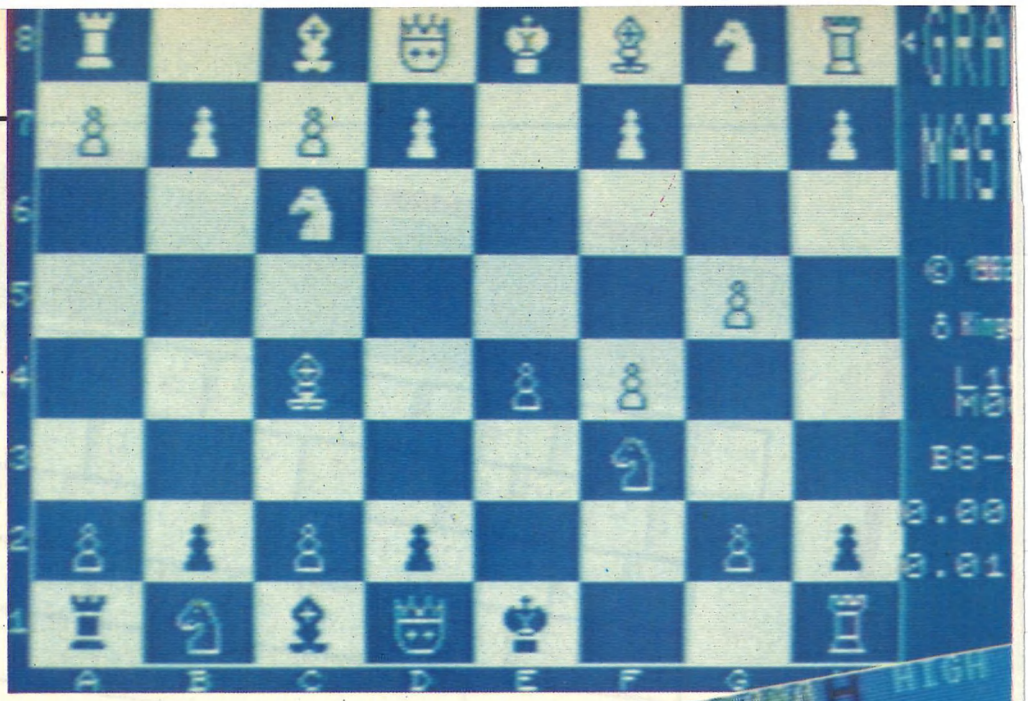
According to Acorn, the following, which are well-known in connection with the Beeb, will be available for adding to the Electron externally:

- Disk interface
- Tube interface
- Econet interface
- RS423
- Printer port
- User port
- Analogue input
- Sideways ROMs

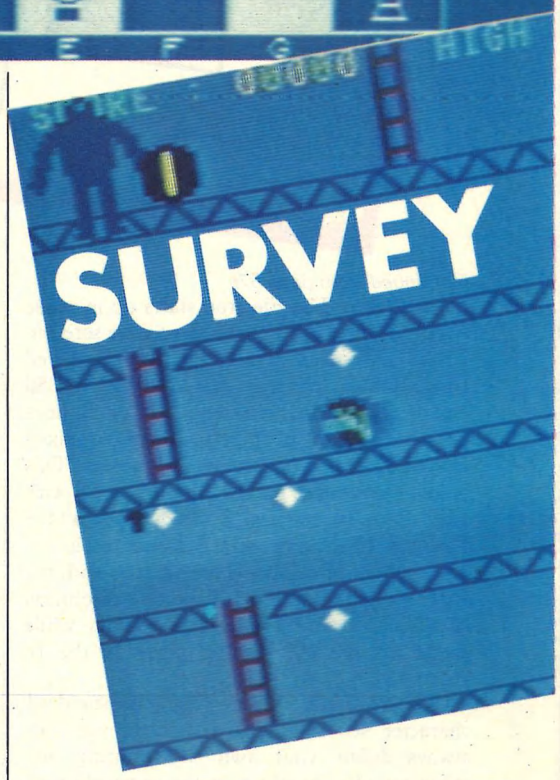
All these will presumably be connected via the 50 way connector on the back of the Electron. There are two brass bushed screw connectors either side which look purpose-made for the very substantial bolt-on expansion system which Acorn is already talking about. No details are available at the moment, but clearly there will be an immediate market for them.

CONCLUSIONS

- The Electron offers almost all of the same programming facilities as the BBC Microcomputer.
- There will be plenty of software for the Electron because of the close compatibility with the BBC Microcomputer.
- The Electron will be expandable.
- At £199 it is more expensive than some people had hoped. Nevertheless, it should sell well because of the reputation earned by its big brother. ■



CBM 64 SOFTWARE SURVEY



MIDNIGHT SOMEWHERE on Terra. I was slumped on a contour couch watching the late show when a World Government announcement suddenly broke in: "All pilots with Gridrunner experience report to joystick port two immediately". It could mean only one thing — the droids were back! The other thing that it might mean, however, is that the *Your Computer* reviewer is space-happy.

As hardware, the Commodore 64 is certainly value for money. With its 64K of onboard RAM — of which 38K is available for Basic programs — a choice of 16 colours and two character sets including predefined graphics characters, plus a fully-fledged sound generator there is no doubt that it is a very appealing machine.

No messing about with 3K or 16K RAMpacks to avoid irritating out-of-memory errors. It plugs straight into your monitor — no PAL modulator required.

But as yet, the software houses seem to find the CBM 64 a positive *embarras de richesse.* Sadly one is left feeling here is a host of rapidly re-implemented Vic-20 programs aimed at cashing in quickly on the new market. It also seems that the machine's larger memory is paradoxically a handicap, permitting lazy programming with extensive use of Basic routines which make many 1K ZX-81 games exciting by comparison.

Melbourne House's Super Cassettes A and B contain plenty of examples of the latter syndrome. The idea is sound. Two bumper-bundle games cassettes backed up by a separate Commodore 64 games book written by Clifford and Mark Ramshaw, containing the actual listings. As an introduction to computing it is reasonably sound. Any book written by two siblings so apple pie-eyed as to dedicate it to "Mom and Dad" cannot be all bad. But there is still room for improvement.

Documentation accompanying the cassettes is wrong in one or two places — always more dispiriting for a newcomer to computing than one long inured to the slings and arrows of outrageous fortune. On Super Cassette A many cats and dogs fell to their doom while I figured out which keys would actually move my catcher left and right. They are M to go right and Z to go left. Rest assured, Cliff and Mark have got it right in their book.

All in all, this is potentially a neat introduction to computing for someone who has never seen Luna Landa on a ZX-81, or who enjoys the rare pleasure of being able to lie back, relax, and have a cup of coffee in between launching occasional rocket salvoes at some of the most cautious and diffident UFOs yet to attempt encroachment on Earth.

Audiogenic's Motor Mania brought a much-needed release from these psychological frustrations — a taste of the open road, albeit somewhat lacking in clear resolution. You participate in a cross-country car rally beset by drunken drivers, potholes, road patches, broken glass, logs, cross-traffic and avalanches. It may not get BSM approval, but it is often the unexpected things that catch you out in a driving test. This is an absorbing test of your reactions but the instrumentation on the right hand side of the screen could surely have been presented with a better definition.

The other CBM 64 offering from Audiogenic is Renaissance, reportedly the full-function, computerised version of the age-old game of Othello. This is not my favourite game and I was still waiting eight minutes later for the computer to make its first move. I guess the CBM 64 is not over-keen on it either.

But it certainly did not get the hump about Attack of the Mutant Camels from Llamasoft. Written by Jeff Minter this at least sounds as though it might be original, although in another life those camels could well have been Imperial AT-AT walkers. Enough of this speculation. In a scenario that, had it been made into a SF movie in 1952 would probably be showing late nights in independent West End cinemas, the Earth is threatened by kidnapped camels, mutated into 90-foot high laser-spitting neutronium-shielded monsters.

The neutronium means that not only can the deadly dromedaries hand it out, they can also take it so you have to be pretty persistent as well as nippy when manoeuvring your rebel snowspeeder, sorry, spaceship around their nobbly knees. As you remorselessly pump your shells into them, they gradually change colour and disintegrate. At least it's better than cold-harpooning whales. Good graphics, remorseless sound effects, this is a fine shoot-'em-up game.

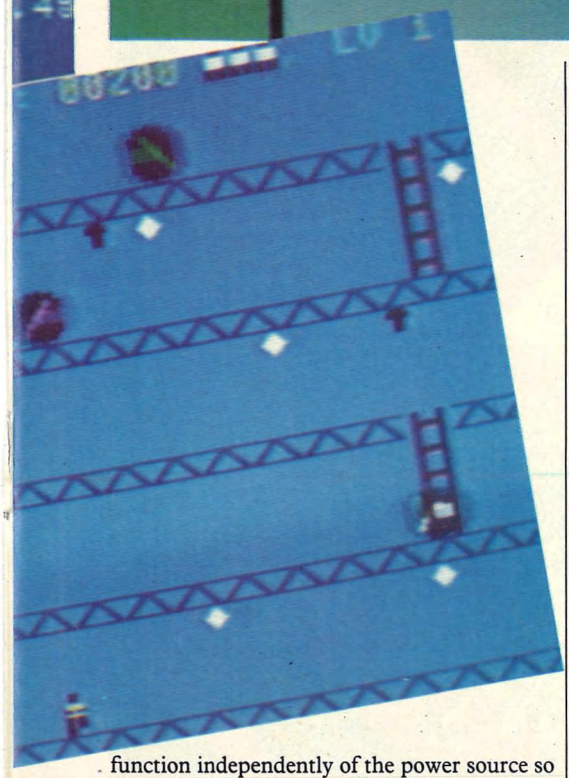
On a musical note, Irving Berlin once said to Cole Porter, "Listen, kid, take my advice, never hate a song that has sold a half-million copies". Likewise, you should never hate a game that is number one in the U.S. popularity stakes. Such is the lot of Minter's best-known baby, Gridrunner, and its even faster offspring, Matrix, is no doubt following in its footsteps.

For those of you who did not serve in the first lot the infamous Grid Wars broke out when alien droids were discovered to be infesting the Earth's vital energy grid, sapping our power. As you probably gathered from the opening paragraph, I was right in the thick of those early battles, zipping around, zapping away with my plasma cannon at the linked droid segments. God, it was hell.

Back then, they traversed the grid horizontally. Pods would lodge on the grid gradually evolving until they hurled a bolt of energy downward. Then there were the X-Y zappers running along two sides of the grid. Their crossfire was what formed the pods, and was very likely to be the end of you if you got caught in its way. I still wake up in a cold sweat thinking about it.

But the return of the droids necessitated the formation of the crack Matrix squadron. Things are no easier. The new ship can

Paul Bond bravely battles Iratian Skullships, duels with mutant camels, gets to grips with Zzyaxian Bugships and, perhaps worst of all, meets the dreaded pink monsters.



function independently of the power source so you are not just confined to the bottom seven lines of the grid. But now there is a fifth column. Watch out for the Snitch — the treacherous humanoid who runs along the top of the grid giving your position away.

How could anyone ally themselves with fiends who use such bizarre psychological warfare tactics? Sometimes camels appear and run down the grid. Argh. These tend to reduce your score. Deflexor waves make your projectiles ricochet off.

Worse, there are diagonal waves of droids — they are no longer confined to trundling back and forth across the matrix. Seven mystery bonuses can be scored, but it is down to you to find out how. Answers on the back of a £5 note to the Spaceman's Rest and Rehabiliation Centre, please.

After all this excitement, Laser Zone comes as a bit of a let-down. It is not particularly interesting visually or aurally. You have to manually co-ordinate two cannons on X and Y axes as Iratain Skullships and Zzyaxian Bugships slide towards the sides of the screen. As the battle progresses rabbitrons, cosmicats and maniac mice show up, and some swear to seeing a camel.

However, the Iratian death satellite does make an entrance and, like the mutant camels, it is coated in neutronium so it takes a bit of blasting since it is well-nigh impregnable.

Also well-nigh impregnable was the documentation for Anirog's 3D Time Trek. Perhaps starship captains really are smarter than spacefighter pilots. They need to be when the manual says things like press D for damage report when it means Ctrl D. You are given no clues as to how to get the galaxy map up. In fact it is M. Still this is apparently a prototype starship.

It is the usual Star Trek format but you get visual acquisition of Klingons flying towards you — a chance for a bit of shoot-'em-up after all that cerebral chart-reading. A competent implementation.

Interceptor Software's Star Trek does not have quite the same pleasures of interactive fighting, but it does give you an option of three types of game scenario: Klingon Invasion, Galactic War and the Final Frontier. The instructions and controls are wonderfully convoluted in the best tradition of Star Trek, but one feels that the sound potential has not been fully realised.

However I should confess that while testing this implementation I was dismissed from Starfleet for genocidal war crimes against an alien civilisation.

The company serves up a reasonable implementation of Scramble which, instead of that rather obscure manoeuvre of bombing fuel dumps to get more energy, has you destroying the forcefield projection dishes which stop the energy being beamed to you from the mothership. Much more plausible.

Interceptor's version of Pac-Man holds no surprises but is certainly a fast enjoyable game. The gulper was not very responsive to the joystick so I should stick to keys on this one. The monsters all have names like Zippy, Stilty and Gippy. There is one rather indolent blob called Chris. Zippy is pink and relentless — as devotees of previous software reviews will know, a pink monster is always very, very nasty.

There are nasty monsters in Panic 64, also from Interceptor. Standard Panic format — only instead of digging a hole in the masonry to cause the pursuing blobs to fall into oblivion, you have to place a time-bomb. This has the rather disconcerting result that they can still bump you off if you misjudge the length of your fuse. There is a fundamental logical flaw in the game insofar as it is quite possible to hang things up by blowing two or three holes in various levels and then standing there while the monsters fall into a loop. This is a no-win situation. Apart from this it is well-implemented.

Crazy Kong — diamonds are a girl's best friend and your job is to collect a load of them at the same time as you are avoiding the barrels that the insane simian is rolling down from the top of his steel fortress where he is holding your girlfriend captive. Apart from assuming that you are male this program also assumes that you can figure out the keyboard version for yourself. Following the documentation, I was crushed to death several times pressing 3 to jump before I discovered you had to press the Ctrl key as well. As for jumping when you hit the spacebar forget it.

For the intellectuals among us, there is always what is described as the world's strongest chess program for home computers. Grand Master from Audiogenic is well-documented.

You can have response times from five seconds up to several days. The latter is for postal chess although, if your brain is as slow as mine, it is quite a useful option. But since the original version of this game will run perfectly happily on a Vic-20, perhaps we can look forward to even stronger programs in the future.

In conclusion, it must be said that the CBM 64 is not yet well served by the software houses, who seem to be in a creative rut. Documentation on many games is atrocious which is one reason that utility programs have not been reviewed here.

So we must look to the future. People who have seen the Chromasonics 3D football game for the CBM 64 at micro shows will believe that great things are possible although development problems made it impossible for them to let us review the game. The advent of Simons Basic will further enhance the machine's capabilities — and the first software house to really use this facility or, indeed, any of the real 64 potential will make a lot of money. But for now, if you are thinking of buying a CBM 64, my advice is don't. In a few months time there will be good software around, and the machine will be cheaper. ■

Company	Program	Price
Anirog 8 High Street Horley Surrey	3D Time Trek	£5.95
Audiogenic PO Box 88 Reading Berkshire	Renaissance Motor Mania Grand Master	£8.95 £8.95 £17.95
Interceptor Lindon House The Green Tadley Hampshire	Panic 64 Scramble Spriteman Crazy Kong Star Trek	£7.00 £7.00 £7.00 £7.00 £7.00
Llamasoft 49 Mount Pleasant Tadley Hampshire	Attack of the Mutant Camels Gridrunner Matrix Laser Zone	£7.50 £5.00 £7.50 £7.50
Melbourne House 380 Station Road Harrow Middlesex HA1 2DE	Super Cassette A Super Cassette B	£6.95 £6.95

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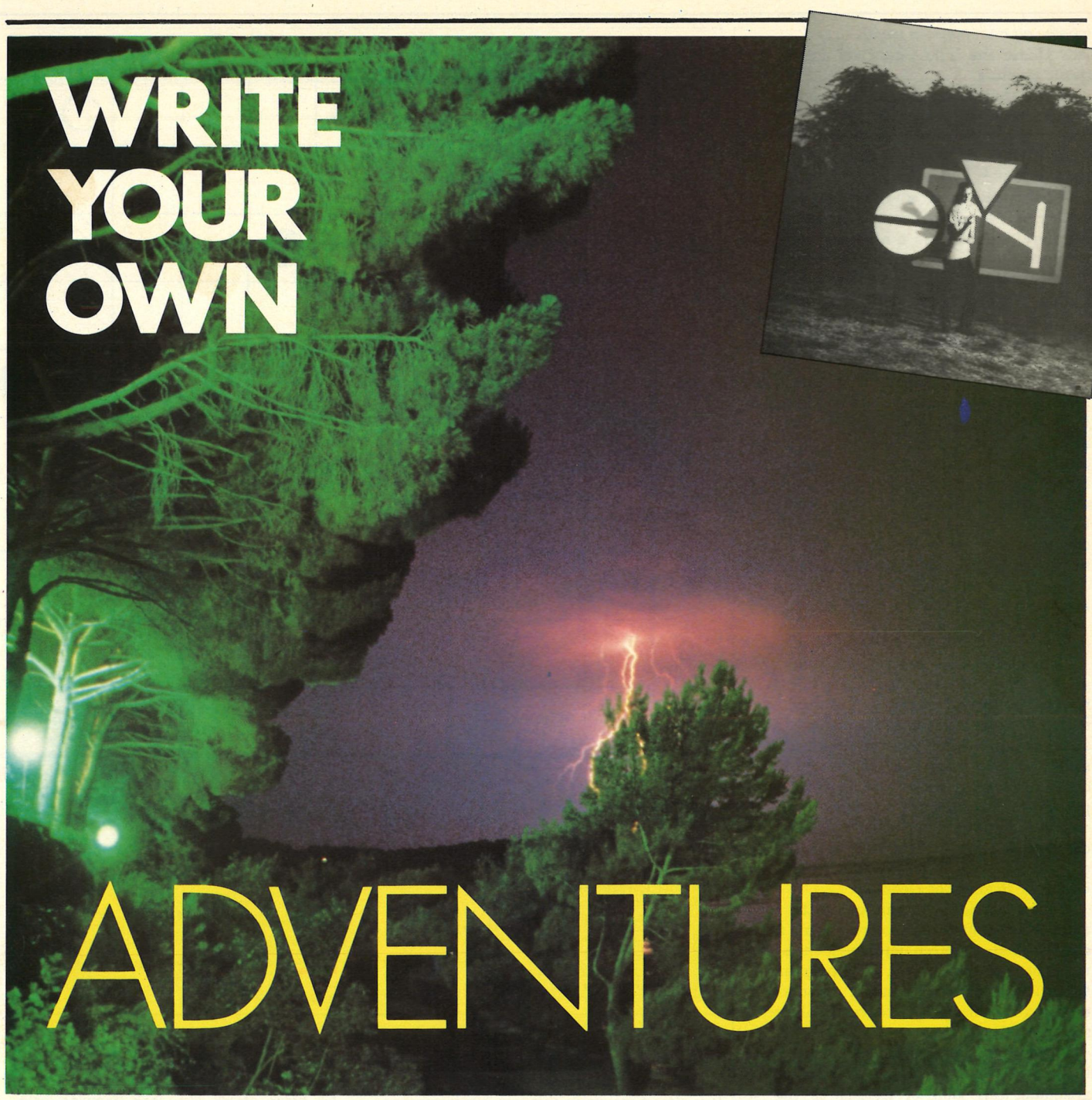


DO YOU LIKE travelling to exciting places and making interesting new acquaintances — some of them human? Can you hold your own in a tussle with a troll or when battling with Beelzebub? Do you have a good sense of direction and an ability to cope with the odd bad spell — as in wizardry, not weather? When did you last tackle a turret and win the unspoken — and best left undescribed — thanks of a beautiful princess?

If you answer "Eh?" to these questions, then it is definitely time that you found your way into computer adventure gaming; and rather than spend £25 or more for a decent ROM cartridge, or something less for what is often something very much less, maybe you ought to know just how easy it is to devise your own adventure storylines and develop them into simple programs that will give you and others hours of fascination, triumph and exasperation.

Unlike the genesis of Space Invaders — it was, you may remember, that dear little game of ping-pong played on an oscilloscope which Willy Higinbotham, an American physicist, invented as a lab entertainment in 1958 — the birth of the computer adventure game or CAG is badly documented. But it undoubtedly grew from some idle programmer's search in the mid-1970s for a text-orientated pastime that he could play when nobody was looking — loosely based on the Dungeons and Dragons concept that was sweeping the United States.

```
1 REM CROWN OF ATLANTIS
2 REM GRID & COMPASS MINI ADVENTURE
3 REM COPYRIGHT JOHN RANSLEY 1983
4 PRINT"{CLR SCR}"
5 REM SET TERRAIN
10 DIM L(10,10)
15 REM MINE RISK
20 M=2
28 REM ZERO GRID
30 FOR I=1 TO 10:FOR J=1 TO 10
40 L(I,J)=0
50 NEXT J,I
55 REM SITE RUINS
60 FOR I=1 TO 6
70 READ R,C
80 L(R,C)=1
90 NEXT I
95 REM SITE CORAL
100 FOR I=1 TO 6
110 READ R,C
120 L(R,C)=2
130 NEXT I
135 REM SITE FEATURES
140 L(2,3)=3:REM FISH
150 L(3,9)=4:REM WHALE
160 L(5,7)=5:REM WRECK
170 L(6,1)=6:REM SPIRE
174 L(7,4)=7:REM SQUID
175 L(8,8)=8:REM ANCHOR
190 L(6,5)=9:REM CROWN
200 REM FIRST POSITION
210 R=INT(RND(1)*10)+1
220 C=INT(RND(1)*10)+1
230 REM MAIN LOOP
```

(listing continued on next page)

Like Higinbotham's ping-pong game, the early CAGs were a kind of cult entertainment that only the knowing tab-collars at IBM and Sperry Univac could play — until the day in 1978 when one of their number, by the name of Scott Adams, sent his mainframe buddies into peals of laughter by revealing his intention to scale down an adventure to fit his TRS-80 with all of 16K.

The rest, as they say, is history. Scott Adams went on to become the author of some wholly original CAGs whose themes have provided the stuff of plagiarism for pale imitators — but his Adventureland, Pirate's Cove, Mystery

(continued on next page)

(continued from previous page)

Fun House and The Count are among the classic originals.

All are well worth playing as examples of inventive and imaginative programming before you try your own hand. Adams is also rightly credited with inventing the puppet, but more about that later.

So what exactly is adventure gaming? In essence, it is a mapped conundrum; an unfolding story, often having a mythical theme, in which you, the player, find yourself in different locations and presented at each with a choice of actions and/or objects, with the ultimate objective of finding hidden treasure, rescuing an imprisoned maiden, slaying a dragon, or whatever.

For example, Adventureland — the Scott Adams title that started it all, and now available in ROM cartridges for many popular micros — involves a trek through increasingly hostile countryside in a quest for hidden treasures. Pirate's Cove, another Adams scenario, takes the player from a London flat on to three other locations; it introduces some particularly strong characters and plenty of humour. The Count sets the challenge of finding a way through the corridors and cellars of Dracula's castle with the aim of staking him out before sunset.

Lateral or 3D routes

From these brief descriptions, you will understand that the routes or playing boards of most CAGs are either lateral, in that they cover several different locations — for example, from a museum to the shores of a secret island, and from there to a magic waterfall — or three-dimensional in the sense that they require the player not only to travel from one room or chamber to an adjacent one, but also to explore different levels of the same building, structure or tomb — such as in House of the Seven Gables or Pyramid of Doom.

Three-dimensional adventures can be very much more complex to conceptualise and flowchart — and on-screen improvisation is not recommended when writing CAG programs — so novices will probably find it easier to cut their teeth on devising a conventional lateral scenario to begin with.

Adventure writers would argue that one of the best reasons for trying your skills at programming this kind of material is that it involves, in an attractive way, all the main building blocks of Basic; variables and string handling, string-chopping and concantenation, randomising, If-Then and loop logic, screen presentation, and — if your micro runs to even limited colour and sound — the optimisation of simple graphics and sound effects.

In short, adventure-game writing can serve as a valuable refresher course in good programming manners — and this also applies, of course, even if you are already into machine code.

There are some notable exceptions to the rule — Melbourne House's innovative Hobbit is one of them — but most CAGs usually sacrifice, for purposes of memory economy, the highly colourful and animated screens of action games such as Frogger or Pac-Man in favour of a screen display comprising simply two or three sentences providing information and inviting or suggesting a response. For example, one screen might read:

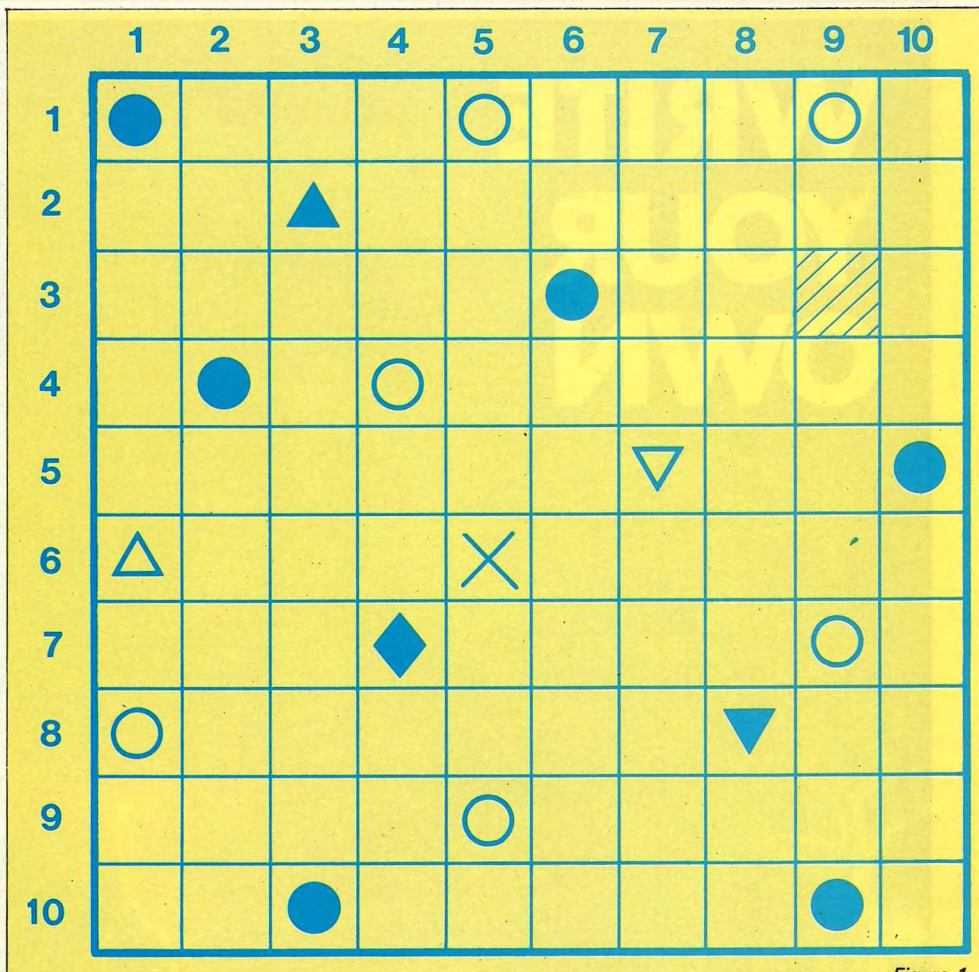


Figure 1.

(listing continued from previous page)

```
240 PRINT"[CD1]YOU ARE DIVING "
250 SQ=L(R,C)+1
260 ON SQ GOSUB 270,280,285,290,300,310,320,330,340:
 GOTO 360
270 PRINT"[CD1]OVER CLEAR SEABED.":RETURN
280 PRINT"[CD1]OVER STONE RUINS":RETURN
285 PRINT"[CD1]OVER PINK CORAL.":RETURN
290 PRINT"[CD1]NEAR A SCHOOL OF FISH.":RETURN
300 PRINT"[CD1]NEAR A WHALE SKELETON.":RETURN
310 PRINT"[CD1]NEAR A SHIPWRECK.":RETURN
320 PRINT"[CD1]ABOVE THE SPIRE OF"
321 PRINT"ATLANTIS":RETURN
330 PRINT"[CD1]NEAR A GIANT SQUID!":RETURN
340 PRINT"[CD1]NEAR AN OLD ANCHOR":RETURN
350 REM YOUR MOVE
360 RS=R:CS=C
365 PRINT"[CD1]WILL YOU SWIM"
366 PRINT"N,S,E OR W?"
370 GET M$:IF M$=""THEN 370
380 IF M$="N" THEN R=R-1:GOSUB 480
390 IF M$="S" THEN R=R+1:GOSUB 480
400 IF M$="E" THEN C=C+1:GOSUB 440
410 IF M$="W" THEN C=C-1:GOSUB 440
420 GOTO 530
430 REM COMPASS ERROR
440 SQ=INT(RND(1)*10)+1
450 IF SQ>2 THEN:RETURN
460 IF SQ=1 THEN C=C+1:RETURN
470 C=C-1:RETURN
480 SQ=INT(RND(1)*10)+1
490 IF SQ>2 THEN RETURN
500 IF SQ=1 THEN R=R+1:RETURN
510 R=R-1:RETURN
512 REM OCTOPUS RISK
514 RO=INT(RND(1)*10)+1
515 CO=INT(RND(1)*10)+1
516 IF R=RO AND C=CO THEN PRINT "[CD1]ORSON THE OCTO
    PUS HAS GOT YOU!!!":GOTO 64
0
520 REM FOUND CROWN?
530 IF R<1
540 IF L(R,
    VE FOU
GOTO 640
560 GOTO 24
570 PRINT"[
580 RR=INT(
590 IF RR<M
    640
600 MR=MR+3
610 PRINT"R
620 PRINT"M
640 PRINT"[
650 GET G$
660 IF G$="
670 PRINT"[
685 PRINT"[
690 END
700 DATA 1,
710 DATA 1,
```

The castle gate is locked.
The ground is soft.
There is a spade nearby.
It is almost inevitable that you would type in:
Take spade
and hit Return. The screen might then prompt:
Now what?
and you may command,
Dig ground.

The pairing of a verb with a noun to make a character string that matches, somewhere along the data line, with those verbs and nouns you have seeded in the program is usually, but not always, the essence of all but the simplest adventure writing.

It merely exploits your micro's ability to interpret and act upon the Left$, Right$, Mid$ and Val functions, and this technique will be described in detail in the second part of this article, in next month's issue.

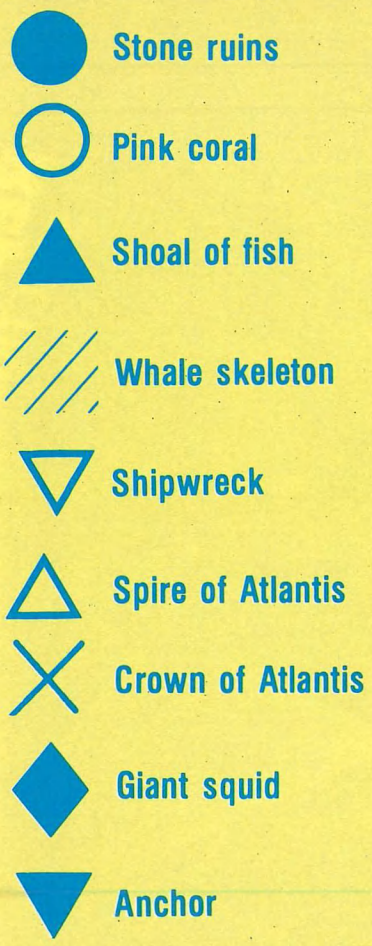
For the moment, it would not be a bad idea, as part of beginning to visualise your own adventure, to start jotting down in a notebook a selection of those short, useful verbs. Here are some of the most popular to get you thinking: North, south, east, west, up, down, go, enter, open, close, push, pull, get, take, move, steal, unlock, drop, give, trap, pocket, hide, follow, eat, swallow, drink, chase, capture, hit, break, attack, slay, look, examine, help.

These are fairly mundane verbs. More imaginative choices may in turn suggest novel actions and confrontations to work into your plot. Anyway, all of them are self-explanatory, with the possible exception of the last three.

The Look instruction serves as a request for more information about a particular location, if any exists. Examine performs the same function in respect of an object. A typical

The variables.

L	Location
M	Mine
RO	Row number of octopus
CO	Column number of octopus
R	Row number
C	Column number
SQ	Square currently occupied
RS	Row number stored
CS	Column number stored
M$	Move
RR	Mine random risk




```
OR R>10 OR C<1 OR C> 10 THEN 570
C>=9 THEN PRINT "[CL SCR]LUCKY DIVER! YOU
ND THE TREASURE!!!"

0
CD1]YOU ARE OFF-COURSE!"
RND(1)*10)+1
R THEN PRINT"[CD1]YOU'VE BLOWN IT!" GOTO
PRINT"[CD1]YOU NOW RUN A HIGH"
SK OF EXPLODING THE"
INE - WATCH OUT!!!" GOTO 365
CD1]ANOTHER GAME? Y/N?"
F G$="" THEN 650
Y" THEN PRINT"[CLR SCR]" GOTO 210
CLR SCR][CD2]THANKS FOR DIVING."
CD1]CHEERIO ME HEARTY!"

1,3,6,4,2,5,10,10,3,10,9 REM RUIN
5,1,9,4,4,7,9,8,1,9,5 REM CORAL
```

negative response to either might be, from a puppet,
I see nothing special.

Finally, Help is a real cry from the heart, to be used only when the player is really stuck. Use of this prompt at any point will usually call up on-screen a clue that will help to make a right next move.

Incidentally, those of you fortunate enough to number a voice synthesiser among your peripherals will readily appreciate the scope for its utilisation as a adjunct to, or substitute for, screen text displays.

The use of puppets

A word about the puppet mentioned earlier. When Scott Adams had completed his first few adventures, he discovered that some players found the practice of having to communicate through a keyboard with what they anyway perceived as a characterless, soulless chip rather too sterile an experience by half.

So the clever fellow hit on the idea of the puppet; an extension of the player — and maybe even of his *alter ego*. The puppet addresses his master, the player, in the first person, so a puppet version of the last example might read instead:
The castle gate before me is locked.
The ground I'm standing on is soft.
I can see a spade nearby.
What shall I do?

Because the language of puppet screens needs to be a little more human, and can thus be rather text-heavy and byte-hungry by comparison with conventional screens, such programs need to be even more economy-conscious.

But puppets are definitely more fun, especially if you give your puppet character strengths and weaknesses of his own, and have him talking back and complaining, C-3PO fashion, about the mess you have got him into when you have made the wrong response.

Just in case all this talk of verb/noun twinning, data matches, string chopping and insolent puppets puts you off adventuring any further, there are some perfectly respectable and highly entertaining commercial adventures which make use of one or two much simpler techniques — the option menu and C and G, or compass and grid. You can learn them easily and write programs utilising them very simply.

Compass and grid

With the option menu, at every significant stage in the adventure the player is presented with, say, three choices of action — he may pick just one of them. Using again the earlier example, the screen might read:
The castle gate is locked.
The ground is soft.
There is a spade nearby.
Will you
1. Turn back?
2. Take spade and dig?
3. Look around?

The player would respond by simply touching key 1, 2 or 3. In this case, option 1 might get him eaten by the monster he did not notice standing behind him. Option 2 could result in the screen announcing that he has dug his way into a patch of quicksand; while option 3 may reveal that there is also a ladder nearby which will let him climb *over* the gate.

One of the big advantages of the option menu, relying as it does on single-key responses such as 1, 2 or 3, or Y or N, is that, of course, it utilises Get rather than Input statements and thus avoids the need for the player to hit Return after keying in every response — a particular advantage when children are playing.

As we can all be clumsy or careless at times, it is an easy matter to program in a mug-trap that will flash up an error message on-screen and let the Run dwell until a correct key is pressed.

The second, even more fundamental technique and one that can be used together with the menu option, is that of the compass and grid — it is really just a crib from the old battleships game using squared-off paper that some of us played as kids. With this, you actually have a little map of the main location or locations — the cellar of a haunted house, say, or a treasure island.

This hard copy is copied into the program with the use of a simple two-dimensional array — the number of rows in the grid being one of the Dim subscripts, the number of columns being the other — together with read and data statements. The program also holds the

locations on the grid of any special features and, of course, that of the object or whatever is the subject of the search.

Because C and G programs are so simple, even the meanest memory has plenty of bytes left over for embellishments such as graphics and sound effects. There is no reason, for example, why your hard copy of the map should not instead be interpreted as a colourful screen display; while winds can howl and monsters can growl as the game proceeds.

When you hit Run, one of the program's randomising lines will place you on a square in the grid. You do not know which one, but make an educated guess from the clue shown on the screen and from comparing this with your copy of the map.

Each screen will invite you to move N, S, E or W — meaning one square up, one down, one left, or one right. Simply touching one of those four letters on the keyboard completes your move and generates the next screen display — which you hope will contain another clue to your new location and its proximity to the treasure square.

It would hardly be fair to compare a C and G game with a full-blown Scott Adams adventure, but it does make an excellent starting point — an infinitely variable challenge to which you can add all kinds of bells and whistles in the form of interesting graphics, animation and sound — rather than fill up your RAM with overdressed routines or wordy screen displays that may be called into use only once every nth game.

Apart from that, byte-busting adventures that can go on for hours may be all right for the Dungeons and Dragons freaks, who I imagine sprinkle energy pods on their cornflakes, but for newcomers to the genre, and especially kids, their frontiers of boredom are likely to be reached within about 10 minutes.

Further, it always makes sense to start simple — and devising and writing a C and G program allows you to do just that. It will be by no means a wasted exercise, because virtually every new trick you learn and mistake you make will serve as an invaluable template of experience when you come to tackle the writing of a CAG proper.

So for now, you will find here the listing for The Crown of Atlantis — a compass and grid program that will start you playing, and thinking, along the right lines. Although written for a Vic-20/Commodore 64, it will run on computers using almost any other dialect of Basic

(continued on page 72)

Softek software for the Spectrum. Dragon and Oric should be available in most major outlets such as W. H. Smith, Lasky's, Spectrum and selected branches of Menzies as well as through our nationwide dealer network. Alternatively fill out this coupon and we'll rush you your Softek game by return of post!

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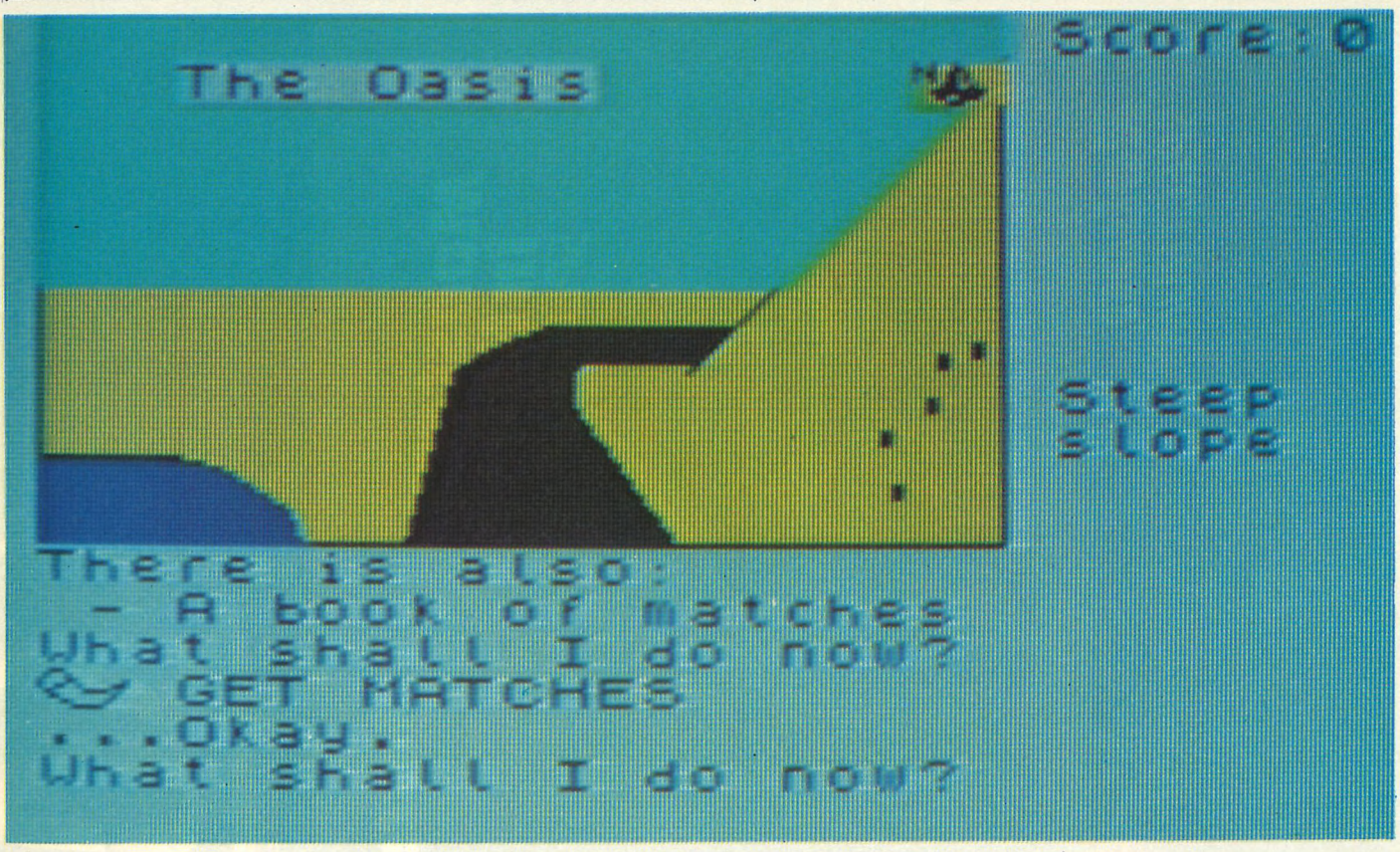


ADVENTURE SC

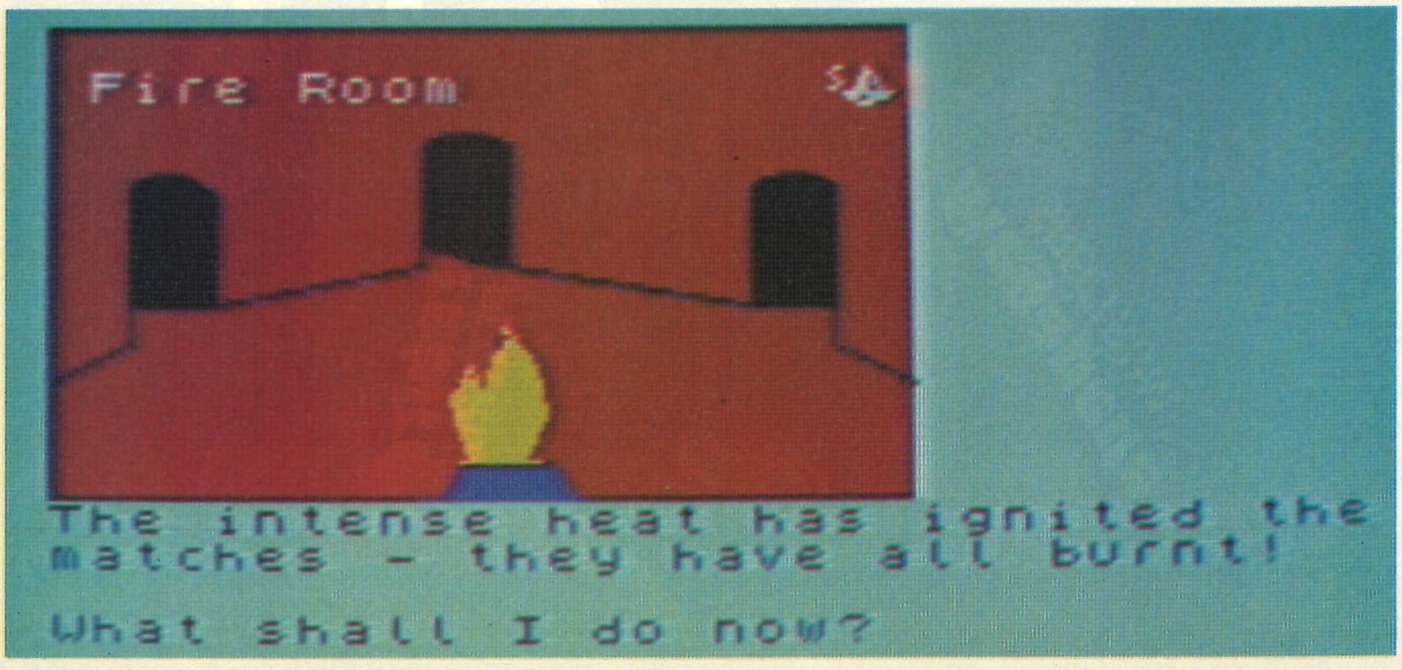
Peter Connor finds a few gold nuggets in the software swamp

FAR AWAY AND LONG ago in the mists of the past, or so the legend goes, the Boffin grew weary of the needs of his faceless master. The boffin craved the excitement of strange landscapes and exotic beasts, the challenge of using logic and luck to succeed in a complex and perilous task. So he created the Adventure, transforming himself from a weedy nine stone computerkid to a musclebound warrior or an ancient wizard or a bold spaceman. Or whatever he wanted. So the legend goes.

The reality is that there is now a plethora of adventure games available for the micro-owners, all descended from this original idea. They all claim to offer you, "in the comfort of your own armchair", the thrill of entering a fantasy world which you can only get out of alive by using a combination of logic and magic.

Adventures require rather more tenacity than the usual game since they are rarely solved in one sitting. The player also needs a high frustration threshold as one of the principles of adventures seems to be W C Fields' motto "Never give a sucker an even break"; you might go back the way you came, but you will not necessarily get back to where you came from.

Level 9's Colossal Adventure, for the BBC



micro, shows how a good adventure should work. It claims to be based on the original mainframe game and, if the loading time from tape is anthing to go by, this may well be true. It is worth the wait though. This program demonstrates one of the essentials of an enjoyable adventure; an interesting and detailed topography. There is a great variety of locations and objects, from the picnic area with some tempting sandwiches — should I eat them? — to the room where you find a gilded cage and the magic, but inpronouncable, word XY22Y.

The object of the game, as with so many adventures, is to find and collect a number of hidden treasures. This in itself sounds rather uninteresting, but in Colossal Adventure it can become a compulsive quest as frustration is outweighed by desire to crack the puzzles.

There is even a touch of sarcasm in some of the computer's comments. If, in a blank moment, you decide to kill something — a fancy that seems to come up on most adventure players at some point — you will be admonished "Are you mad? You should only kill your enemies". Suitably chastened, you try once again to summon enough brain-power to find those elusvie treasures.

Lack of inventiveness

Also for the BBC, Acornsoft's Countdown to Doom is, unfortunately, not up to the Level 9 level. Anyone who has played Acornsoft's Philosophers Quest, a game of comparable quality to Colossal Adventure, will be very disappointed. There is a lack of inventiveness and wit in Countdown to Doom which makes it just a little bit dull.

Here, you are an astronaut in your crashed spaceship. Your task is to find the wherewithal to repair it and make good your escape. Initially you encounter a blocked door, the answer to which seems to be the explosive and fuse you see lying on the floor. Once you are outside you encounter a depressingly familiar adventure game landscape; the evil-smelling swamp, the steaply-climbing track, the jungle, the glacier. It is all so uninspiring that you do not really care where you end up next.

Sphinx Adventure, also from Acornsoft, is rather better, but not much. The locations are familiar, but are described in slightly more detail. There is the forest, the sorcerer's lair, the sword chamber, and so on. One or two odd characters make an appearance, such as the axe-throwing dwarf and the bearded pirate, but do not really justify their presence.

There is quite a choice of adventures for the Spectrum, most of them rather uninteresting. One of the better games, but dull nonetheless, is Bug Bytes' The Castle. In this you have been condemned by a nasty old wizard to collect six treasures or remain forever in his domain. Although the locations are not described in any great detail, they are reasonably interesting. There is, for instance, a Black Chapel in which stands a statue of Medusa; a passing aquaintance with Greek mythology should be enough to make you wary of petrification.

Diamond Trail, from Gilsoft, is another tolerable game for the Spectrum. The drawback with this one is the in-joke location; you are in Spectransia and must find the Sinclive Diamond. Once you have got over that the game itself is not bad. The locations are quite interesting — police HQ, a junk shop, a tube station — and there is even a touch of wit; when you are hungry you are tricked into entering the command Eat Cat, to which the computer replies "I wouldn't touch it with a barge pole, let alone eat it!" It is not a great belly-laugh, but in the land of adventures you have to make the most of everything.

Magic Mountain and Pharoah's Tomb, both from Phipps Associates for the Spectrum, introduce a graphic element into the adventure; each new location is represented by a drawing made before your very eyes. Sadly, the finished drawings are of little interest and take so long to complete that they would have been better forgotten.

You must gather treasure

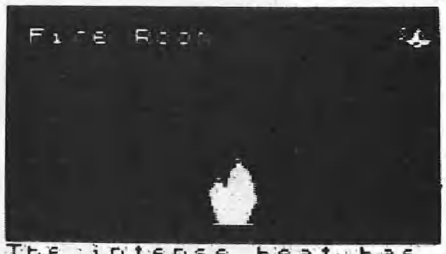
In other respects, these two programs are straightforward adventures. In Magic Mountain you seek the mystical scroll of wisdom hidden deep in the chambers of the mountain. Fortunately, there are some pleasing moments on the trail. At one point you encounter a dwarf with a stall whose sign says "Scythes sold and Fortunes told". My advice is to buy something and ask a question, despite his disgusting habit of cleaning his nails with a curiously shaped dagger.

Pharaoh's Tomb is a very similar game. This time you have to gather treasure at an oasis. When you want to push a rock, you may

(continued on page 70)

OFTWARE SURVEY

COMPANY	PROGRAM	MACHINE	PRICE
Level 9 Computing, Dept Y, 229 Hughenden Road, High Wycombe, Bucks, HP13 5PG.	Colossal Adventure	BBC	£9.90
Microdeal, 41 Truro Road, St. Austell, Cornwall.	Jerusalem Adventure	Dragon	£4.75
	Williamsburg Adventure	Dragon	£4.75
Severn Software, 5 School Crescent, Lydney, Glos.	Holy Grail	Oric	£6.95
Pase Software, 213/215 Market Street, Hyde, Cheshire.	Adventureland	Oric	£4.99
Bug Byte, Mulberry House, Canning Place, Liverpool.	The Castle	Spectrum	£6.95
Gilsoft, 30 Hawthorn Road, Barry, South Glamorgan	Diamond Trail	Spectrum	£4.95
Phipps Associates, 99 East Street, Epsom, Surrey.	Magic Mountain	Spectrum	£4.95
	Pharoahs Tomb	Spectrum	£4.95
W. B. Soft, 191 Seamer Road, Scarborough, N. Yorks.	Adventure 1	Spectrum	£5.95
Anirog, 26 Balcombe Gardens, Horley, Surrey.	Zok's Kingdom	Vic 20 16K	£5.95
	Pharaoh's Tomb	Vic 20 16K	£5.95
Wintersoft, 30 Uplands Park Road, Enfield, Middx.	The Ring of Darkness	Dragon	£10.00
Acornsoft, 4a Market Hill, Cambridge, CB2 3NJ.	Countdown to Doom	BBC	£9.95
	Sphinx Adventure	BBC	£9.95



(continued from previous page)
be asked "Are you sure you want me to risk having a hernia?'

W B Soft's Adventure 1 is an exceptionally dull program in which Steve Silver has to find and repair his captured spacecraft. There is no detail to the locations, for example, "I'm in a forest". OK, but what kind of forest? I would like to know. Not a hint of humour enlivens this boring game.

Zok's Kingdom and Pharaoh's tomb, two games for the 16K Vic from Anirog, are examples of a recent development in adventure games. Both have a mixture of the usual adventure features and tasks where you have to move your graphically represented player to avoid, or fight with, enemies.

According to Anirog's blurb, these games test your speed and ability to think and plan under pressure. If you had the body and brain of a tortoise they might just do that. By trying to combine the action game and the adventure game Anirog have fallen heavily between stools; what you get is a dull adventure with dull graphics.

Wintersoft's The Ring of Darkness, for the Dragon, suffers from similar drawbacks. It starts like a conventional adventure; "Four Rings the Ancient Wizards forged and cast against the earth. One ring the evil sage called forth from the void . . ." and so on, in sub-Tolkein view. You can choose your character — elf, dwarf, or human — and the skill you want — thief, warrior or wizard.

Then, however, the format changes. A map appears, on which your position is represented by a Z. This you manoeuvre with the cursor keys. With tedious frequency you encounter bandits and evil rangers with whom you must either fight or flee. Little else seems to happen in this so-called enchanted land; you need none of the usual adventure skills of logic or lateral thinking.

Adventures in Jerusalem

Microdeal has a series of adventures on the market for the Dragon. Jerusalem Adventure is set in the ancient biblical city and is, thankfully, a conventional adventure game. No graphics here. You have to find nine hidden treasures while out-manoeuvering Arabs that will kill you if you enter their quarter of the city. This is an unpleasently racist note in what is otherwise a laudable attempt to put some new life into the adventure game location. You are advised to be religious at the Western Wall. Pray a lot. Say magic words. Some of the objects encountered are lost through a lack of convincing detail of the locations.

The Dragon, of course, is closely modelled on the American Tandy Colour Computer, and this transatlantic influence is prominent in Microdeal's programs. Williamsburg Adventure will be mystifying to most British players since it relies on a knowledge of, and interest in, American history.

If you do not know or do not care what William and Mary College or Scribner's are then you are not going to have much fun playing this game. This is unfortunate, because Williamsburg Adventure has its moments of wit and interest. But if software houses are going to market American products, they might at least ensure that they are comprehensible to the old world consumer.

Severn Software's Holy Grail for the Oric barely qualifies for inclusion in this review. You are, supposedly, looking for the Holy Grail in the castle. This latter, though, appears on the screen as a grid around which you can move horizontally or vertically. You might get bonuses of gold or wound salve, or you might meet zombies, orcs or wolves; never fight, just run. There is no detail or challenge in this game.

Adventureland is a Pase Software game for the Oric and is, happily, more like the real thing. Although there is again a lack of detail, the game is at least cryptic and intriguing, requiring a certain amount of deductive skill to achieve anything. There are magic words and undiscovered creatures — be careful, they might bite.

Getting a raw deal

You might think that, given the limitations of the machine, it would not be worth writing an adventure for the ZX-81. Bug-Byte has, however, produced the not very originally named Adventure. You must look for the missing three pieces of the Royal Sceptre, put them together and return them to the Emperor. The game is, of course, fairly rudimentary, but when you bear in mind what some of the games for more sophisticated machines are like, it is not so bad.

At the moment adventure game fans are getting a raw deal. Of the programs reviewed here the only one that is wholly admirable is Level 9's Colossal Adventure. Too many games rely on a borrowed scenario without trying to add any original elements. Why so many dwarves and wizards? Why not an adventure set contemporary Britain with cops and robbers or skinheads and greasers? Why not just about anything but the boring old forest, swamp and dungeon? Shabby graphic displays do nothing to better a dull game. What software houses must find now is writers with a little imagination. ■

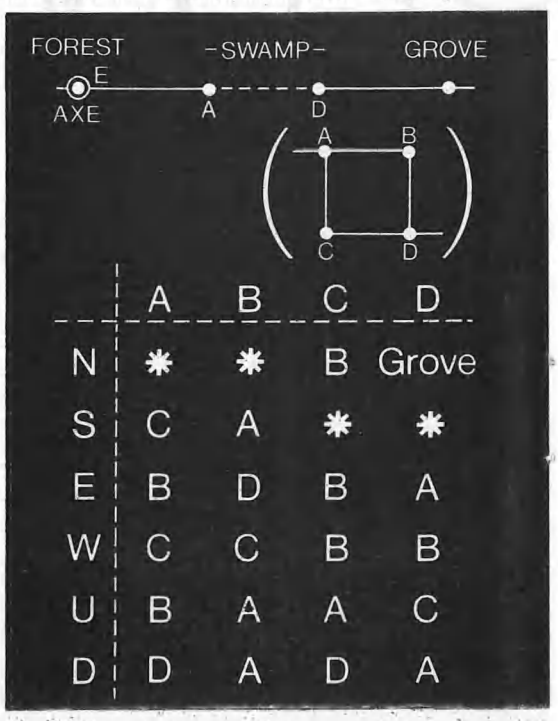
HOW ADVE

YOU HAVE BEEN STARING at the screen since midnight, the rest of the house has gone quiet and there is nothing but the sound of your black coffee going cold for company. That and the dragon of course

The dragon's been sitting there eyeing you from behind the television. It has been a steady war of attrition since you stumbled into the cave about an hour ago; before then you did not know about being driven back by scorching flames. You have learnt a lot in the last hour. First you tried throwing in the onion in the hope it would cry out its flames — brilliant! . . . it swallowed the onion . . . The sword then, the sword! it swallowed the sword too . . . So now you are sitting here glaring across a keyboard at a dragon that has systematically eaten everything you ever owned and wishing that you'd never agreed to swap your old invaders cassette.

Dealing with the dragons

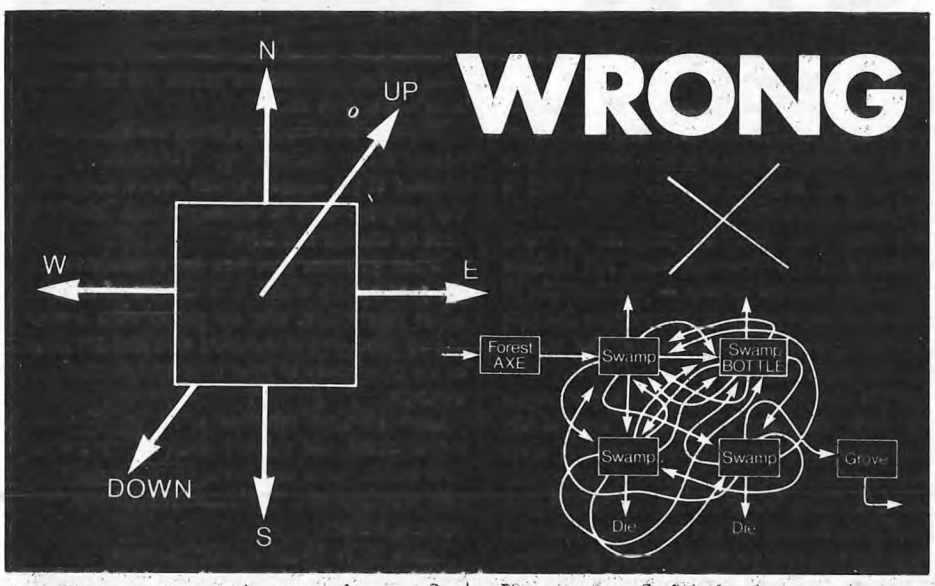
If someone had not got bored with batch processing on a mainframe it might never have started, but once the first adventure game had been written there was no stopping them or the growing band of addicts patiently awaiting the latest releases. Since they first became available, adventures on micros have become both better at understanding what you type, and larger and more varied in their scope. At the same time writers have been inventing



	A	B	C	D
N	*	*	B	Grove
S	C	A	*	*
E	B	D	B	A
W	C	C	B	B
U	B	A	A	C
D	D	A	D	A

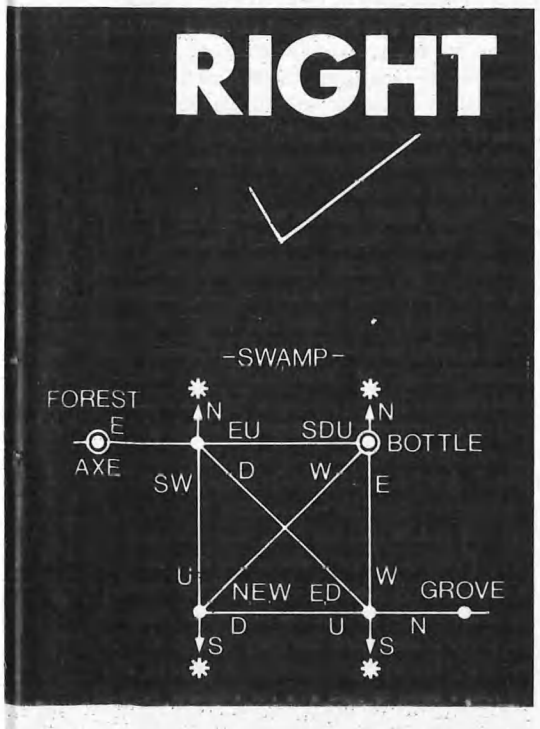
TO SOLVE NTURES

Nigel Hubbard explains how to cheat the monsters and recover the treasure.



ever more tortuous puzzles to perplex you. So you are quite likely to come to a halt faced with something that you are convinced is impossible. Especially if it is your first adventure.

This is where the fun starts though. When you have woken the house after getting past your first tricky obstacle you'll know what I mean. So that you do not have to learn everything the hard way here are a few tips for dealing with dragons and their friends.



If you often find it hard to retrace your steps, you get lost a lot and you have not got a clue what this place you are wandering around looks like then you are probably a bad mapper. You get them everywhere scribbling on the back of their seventh envelope and scrabbling around for the map of the last room they got killed in. To be a good mapper start by getting some nice big bits of paper, keeping one or two for the total map and the rest for working out what this new area you have just found really looks like. You may need to redraw the whole thing or jump to another part of the sheet when you reach the edge but, obvious though it sounds, you will be surprised how much more fun it is not having to search for scraps of paper and knowing exactly how the whole adventure fits together. If you get into these good habits you will race along until suddenly you are lost in a steaming swamp and directions do not seem to make sense anymore.

Maze mapping rules

At first mazes can seem pretty pointless. You go east then west but you are not back where you started. So you panic and go up, down, in, out, north, east, south and west and you are still lost in a steaming swamp. Do not give up though, there are quite a few tricks to save you from starting at the beginning again and sloshing through by trial and error; and when you have finally cracked the maze it looks very impressive to be able to run through it without giving it a thought.

The first rule is to walk into the maze carrying as much as you can. Wear everything that the computer will let you, put things in your pockets if possible and then just start dropping one thing in every new place you come to. Now instead of everywhere looking the same you will start to be able to get your bearings. Going east from the bottle takes you to the elephant, going west, to the Lamborghini and so on. If you are drawing a map of a maze like this then you will soon see that there is no point in trying to make sense of the directions themselves. Just put a dot for each location and simply draw one line between each pair that are connected writing the relevant directions at each end. This will be good enough to get you through most mazes.

The real puzzles

In some mazes a simple map is not enough though, as before long it will start to look decidedly wayward and weblike. The trick here is to draw up a table similar to the one shown here. For each new location that you find, add a new column to the table headed by the object that you have dropped there. Then down the side list all the directions in which it is possible to go. Now it is a simple task to systematically fill in the body of the table with the names of the objects that you reach by going up from the sword say.

You are now in the same position as everybody else when you arrive at the swamp. Beware though! As always, things will never be quite as they seem. The writer may have decided that people are getting a little too complacent and the first thing you will notice is that the golden ball that you were sure you dropped around here has been stolen. Then things start getting tough again and if when you drop your first object it sinks into the swamp with a gurgle and disappears, take a deep breath because you are on your own.

Now that mazes seem altogether less threatening we get back once again to the dragons of adventure games: the real puzzles that they were set for in the first place. If you are expecting me to tell you what to do when your spaceship is rushing towards an asteroid or when your schooner is about to be marooned off Easter Island or simply why you keep dying when you attack the Dobermann Pinscher then you have the wrong idea already. You are the one who is going to solve all of those problems and more before you have finished. If you have a mental block then go and look round another part of the adventure or better still go and make yourself a cup of coffee. Then you will be ready to attack

(continued on page 72)

(continued from previous page)
the problem properly.

Now write down everything you have come across that you cannot explain yet: things and places, remembering that even an object that you have used and broken, such as a bottle that you have had to smash, may have needed to be used elsewhere as well. Now in any good adventure there will be some reason for everything being there. The chewing gum may not look much use, but what about the old dragon, everyone knows you can'nt swallow chewing gum. So go off and try it, you never know; and even if it does not work it will have been a good idea. Making connections like this, often the obscurer the better, is the key to finding the way to a solution.

If the adventure has been written properly then even if you have finally solved something by trial and error, you ought to look back with a wry smile and wonder why it had not been obvious to you a few minutes ago. A bit of inspiration now and then should be all that you will need. If the overall game or a particular section reminds you of a book then it is worth looking it out and reading what really happened in *The Hunting of the Snark* or how Pooh beat Piglet at poohsticks. Perhaps it suggests a film or even a painting; you never know what the writer might have been alluding to and an extra clue never does any harm. As with the objects that you find lying around do not assume that the description of a room is just there for setting the scene. You never know when someone is trying to tell you something. Keep an eye open for any bad puns as well.

Many games available

If you follow all those ideas you should stay on the move for a bit longer than before and not mind so much when you get stuck. Luckily for us all, there are a lot of games available. In general, with adventures even more so than with video games, you get what you pay for. Buy adventures that exploit the full memory of your machine, that way not only do you get more to explore but the computer is more likely to understand you when you try to do something. Generally the more work that has been put into writing the game the more fun it will be to play; a good one is worth the extra.

Finally, the future is written on disc. The opportunities for writing adventures with plenty to explore, describing everything you see in detail and being able to make the computer far more intelligent at understanding commands, are just too tempting. Never believe people who tell you that they are saving up for drives because they are fed up with loading programs from cassette; the true reason is that they have their eyes on some disc adventures.

Acornsoft among other companies will be expanding its range of adventures to include large games especially written for disc. With the added scope for original ideas that these will offer, the next few years should be an exciting time for players. I hope, at least, you have been tempted now either to start adventuring or to go back and solve the puzzle that had you beaten. You will be glad you did. Good luck with the dragons! ■

WRITE YOUR OWN

(continued from page 65)
with only minor alterations. For example, almost every micro has a slightly different syntax for creating random numbers, and that used in this listing may not work with a Dragon or Spectrum.

To help you get this program up and running fast, the program does not include lines of text on how to play – you may like to add these when you adapt the program and jazz it up with your own refinements. But this is what the game is all about.

In The Crown of Atlantis, you are an aqualung diver searching a particular area of the Atlantic's seabed beyond the Straits of Gibraltar, for the legendary underwater city and its greatest treasure. You have memorised the grid map shown in figure 1 and therefore know the locations of coral growths, ruins and other notable features, such as a whale's skeleton and the famed Spire of Atlantis, by which you can reckon your position.

You move around the seabed by touching one of the keys N, S, E or W. You will be told whether you are in a clear area or close to one of the features that will help you to get your bearings, and then be invited to move again.

There are, however, three obstacles to the completion of your mission. First, the strong currents may force you in a direction slightly different from that which you intended; this is a random factor and so you can never be completely sure that you are not, in fact, where you hope you are!

Secondly, equally random is the hiding place of a particularly irascible example of the *Octopus Vulgaris,* who will draw you into his ring of tentacles in seconds and from which there is no escape.

Thirdly, you risk overshooting the area of seabed represented by your 10 by 10 square grid, in which case the screen will show a warning to this effect.

But if you do overshoot there is, initially, a one-in-five chance that you will swim straight into an unexploded wartime mine, which will at least provide the octopus with a convenience food. The second time you overshoot, the risk of blowing your mine precisely doubles. The third time you make this error, you have virtually no chance of surviving.

By studying the program, you should be able to work out how to increase, decrease or vary these hazards and factors, or introduce new random elements. If you have a TI$ or time function, then you can add to the diver's problems by giving him only a fixed amount of time to find the treasure before his air supply runs out and so on.

You may also choose to make the whole game much more difficult by randomising the location of the actual treasure – just check out the program logic to identify which lines you need to change and how.

When you feel that you have exhausted all the possibilities which The Crown of Atlantis offers your micro, why not get to work dreaming up your own idea, using this first program as the bare bones of your own imagination and ingenuity.

Line 10 first reserves a 10 by 10 array representing the playing grid; in future the first subscript in the brackets will signify the row number and the second subscript, the column number.

Lines 30 to 50 fill all 100 positions with an initial value of 0, representing a blank square, or clear seabed. Lines 60 to 90 award a value of 1 to each of the stone ruin locations specified by the data in line 700 – where, for example, the second pair indicates that a stone ruin has to be sited in row 3, column 6. Lines 100 to 130 serve the same purpose in respect of the coral locations, drawing on the data in line 710.

Lines 140 to 190 fill seven more locations, one subscript pair at a time, with other features, including the location of the treasure.

Lines 200 to 210 generate a random row and column for the grid position occupied at the beginning of each game. Screen prompts are triggered by lines 240 to 340, depending on the L or location value acted upon in line 260. Line 360 stores the current row and column for the next update.

Get rather than Input is used in lines 370 to 410 to avoid having to hit Return after choosing every turn. Incidentally, touching any other key will, on the Vic-20 anyway, simply freeze the move and not crash the Run.

The routine in lines 440 to 510 introduces a randomly-occurring deviation in the direction of movement, plus or minus one square. Lines 514 to 516 generate a random position for the octopus and compare this with the player's current location. The off-course message is triggered by line 530 – and may in turn trip lines 580 and 590. Otherwise, line 600 amends the risk factor for the mine set in line 24.

Alternatively, line 540 detects if the current position matches that of the Crown of Atlantis and if so, branches to the play option in line 640. Or if the current position is neutral, line 560 loops back to line 240 for another turn. ■

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The Hobbit. More of an experience

"After a very short time I found that 'The Hobbit' was becoming almost a way of life rather than a game, and so when I finished it for the first time I was partly sad because I felt that all the fun and adventure had ended, but I was wrong. Even now I am discovering new things about the game and feel that it will be some time until all of its secrets are revealed to me."

MR. J. STERN, Herts

"I have at last received your 'Hobbit' program and would like to congratulate you on its excellence. After four days of sweat and tears I have completed only 37.5 per cent of the adventure. The program has lived up completely to expectations, and there is no doubt about it being the best production for the Spectrum to date. You have surpassed all others wi[illegible]s program."

"A lot of fun."

COMPUTI[illegible]

"The excellent gra[illegible] The exciting differ[illegible] is that it is possibl[illegible] converse with all t[illegible] meet and ask their[illegible] recommend this g[illegible] Tolkien, or novel a[illegible]

POPULAR COMP[illegible]

"I am writing to co[illegible] 'Hobbit'. I think it is one of [illegible] ingenious programs I have [illegible] to use. It has kept me stump[illegible] months. I think the effort th[illegible] has go[illegible] writing a program like this must have be[illegible] enormous. The effects are brilliant to say th[illegible] least."

JEREMY CHESTER

"T[illegible]bit takes first place in the new [illegible] quality and value for money."

SINCLAIR USER

[illegible]cations in the Adventure are [illegible]e excellent graphics. We [illegible]plete 7.5 per [illegible]t of [illegible]ures. The [illegible]ied plot [illegible]erior to any [illegible] for the [illegible]

[illegible] COMPUTER

[illegible]isty Mountains [illegible]e, this game is [illegible]reat to play and is No. 1 for [illegible]nd excitement."

GORDON DEMPTSTER, Scotland

"Thanks again for an excellent game in 'The Hobbit'. I feel I have really got my money's worth out of playing time. Congratulations!"

MR. P. RUSHTON, Leeds

"The most powerful computer game yet invented."

COMPUTER WEEKLY

"Within my circle of friends this game has become something of an obsession. We meet every Friday night at someone's house and spend 3-4 hours on 'The Hobbit'. Friday night would not be the same without 'The Hobbit'."

CHRISTINE VERCHILD, Wilts

"One new Adventure game stands head and shoulders above the rest. It alone almost provides you with a good enough reason to buy a 48K Sinclair Spectrum. Not only does The Hobbit produce drawings of the main scenes, but it also understands proper sentences rather than pairs of words for its commands. It comes with a copy of J.R.R. Tolkien's classic book of the same name. It is the program with the most detailed and best written documentation ever."

WHAT MICRO

"This is an impressively packaged Adventure game which makes good use of the Spectrum's colour graphics. They have not only produced one of the best games for the Spectrum, but given everyone else a lesson in good game design."

PRACTICAL COM[illegible]

"I am the owner of a copy of 'The Hobbit' which is wonderful entertainment, and very challenging. I have other tapes and publications of yours, all of which are excellent."

MR. D.J. BURGH, Kent

"Having received the most excellent piece of programming I have ever seen, we have had no social life whatsoever. 'The Hobbit' has been dominating our lives since January and many nights have been spent until 3 o'clock trying to conquer it."

SIMON ROGERS, Avon

"I have recently purchased your excellent adventure game 'The Hobbit'. This [illegible] greatly enhanced by the use of [illegible] graphics, its availability in [illegible] originality of having [illegible]ly to [illegible]

Melbourne House

than a program:

"In my software library, your program 'The Hobbit' takes first place."

DAVID MAXWELL, London

"I am the proud owner of your excellent program 'The Hobbit' and have alre many happy, restful, relaxing hours trying to solve its

d for my ZX you supply called n excellent the money. I find ery realistic. The accurate. It sticks e book, which is a it very compelling tive.

VEN CASSIDY, Essex

ving recently purchased a Sinclair Spectrum I decided to buy 'The Hobbit' since I have been doing a literature project based on 'The Hobbit' with my class of 10 and 11 year old children. Over the last 10 weeks the children, having read the book, have been attempting the program with my assistance. Let me congratulate you on a most entertaining program."

MR. K. REID AND CLASS 7, Nottingham

". . . more of an experience than a program!"

POPULAR COMPUTING WEEKLY

". . . the most unique factor of this program is that the user instructs the computer in completely ordinary English sentences. The Hobbit program is capable of very sophisticated communications . . ."

ZX COMPUTING

"I purchased 'The Hobbit' not long ago and since then I have been engrossed in the game, and I'm beginning to think no-one wants to talk to me as all I talk about is my adventures in, 'The Hobbit'."

DAVID ROWLEY, Stoke-on-Trent

"The use of graphics is one of the features which makes The Hobbit special. The addition of graphics as good as these adds a whole new dimension to the Adventure. It is certainly a marvellous game, which should set the standard for future Spectrum adventures."

ZX COMPUTING

atulate you on a . I have enjoyed mensely. I must thank you oducing such a clever product, it was worth every penny of the purchase price."

MRS. J. RYCRAFT, Northampton

"'The Hobbit' is a beautifully constructed, frantically-maddening, tortuous, gloriously inconsistent, thoroughly spooky adventure – far better than I could have hoped for and certainly the finest of the dozen or so adventure programs I have. In short, I congratulate the four who sweated for a year and a half to concoct such a super result."

MR. PETER JONES, South Glam

"Nothing is certain in this Adventure, but uncertainty! Add to this the brilliant graphics that are used to describe many of the locations and we have an Adventure that is going to become a classic for the Spectrum.

POPULAR COMPUTING WEEKLY

"I am writing to congratulate you on your excellent program 'The Hobbit' for the Spectrum. I wake up in the middle of the night with an idea and have to load the adventure to try it out."

MR. PHILLIP DARLING, Suffolk

"A most impressive package."

DAILY EXPRESS

"...we are not eating food...we are losing sleep...and it's great! I reckon you can guess why. We are lost, completely and utterly lost, in the Hobbit program."

MR. JOHN HARRIS, Kuwait

"...one of the most complex games for the Sinclair machines I have seen..."

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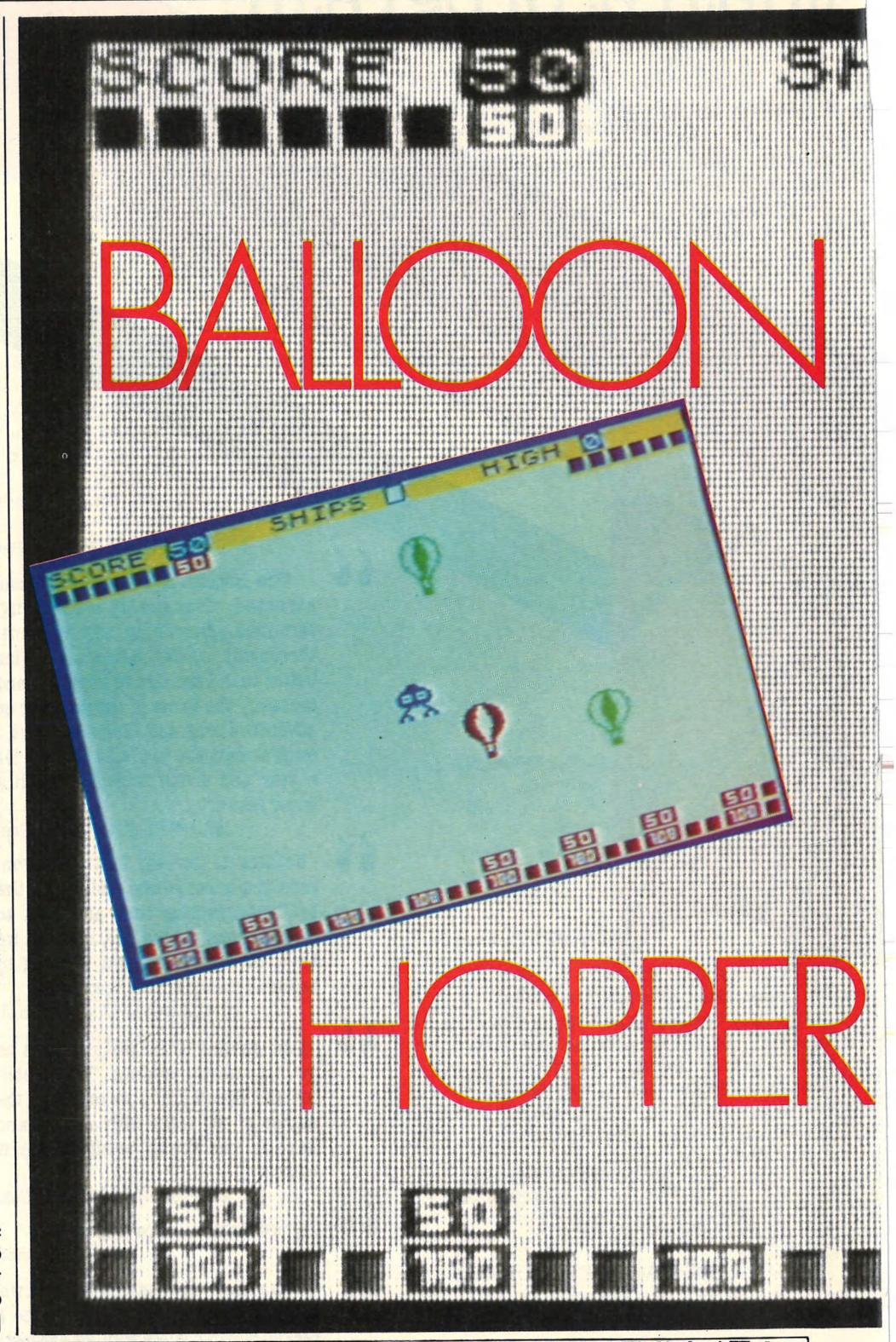
BALLOON HOPPER



LIFE IS HARD at the spaceport, especially if you are the pilot of Balloon Hopper. You control a cargo hopper, a small flying transporter capable of lifting one piece of cargo at a time. The hopper is used to load the spacecraft at the top of the screen with any 10 pieces of cargo that can be found at the bottom. Each piece of cargo loaded scores either 50 or 100 points and there is a bonus of 200 points for each ship fully loaded.

Sounds easy? Unfortunately you have picked the wrong day to be the pilot because there is an air-day nearby and stray balloons keep floating in your way and hindering your job.

Each time you hit a balloon the explosion caused by the hydrogen-filled balloons weakens the hopper's force-field. You can survive four hits before your hopper can no longer function.

Initially there are three balloons in your way; this increases by one for each starship you load. You move using the cursor keys and you must land on top of a piece of cargo to pick it up. To drop the cargo you simply take it to the top of the screen avoiding the balloons on the way.

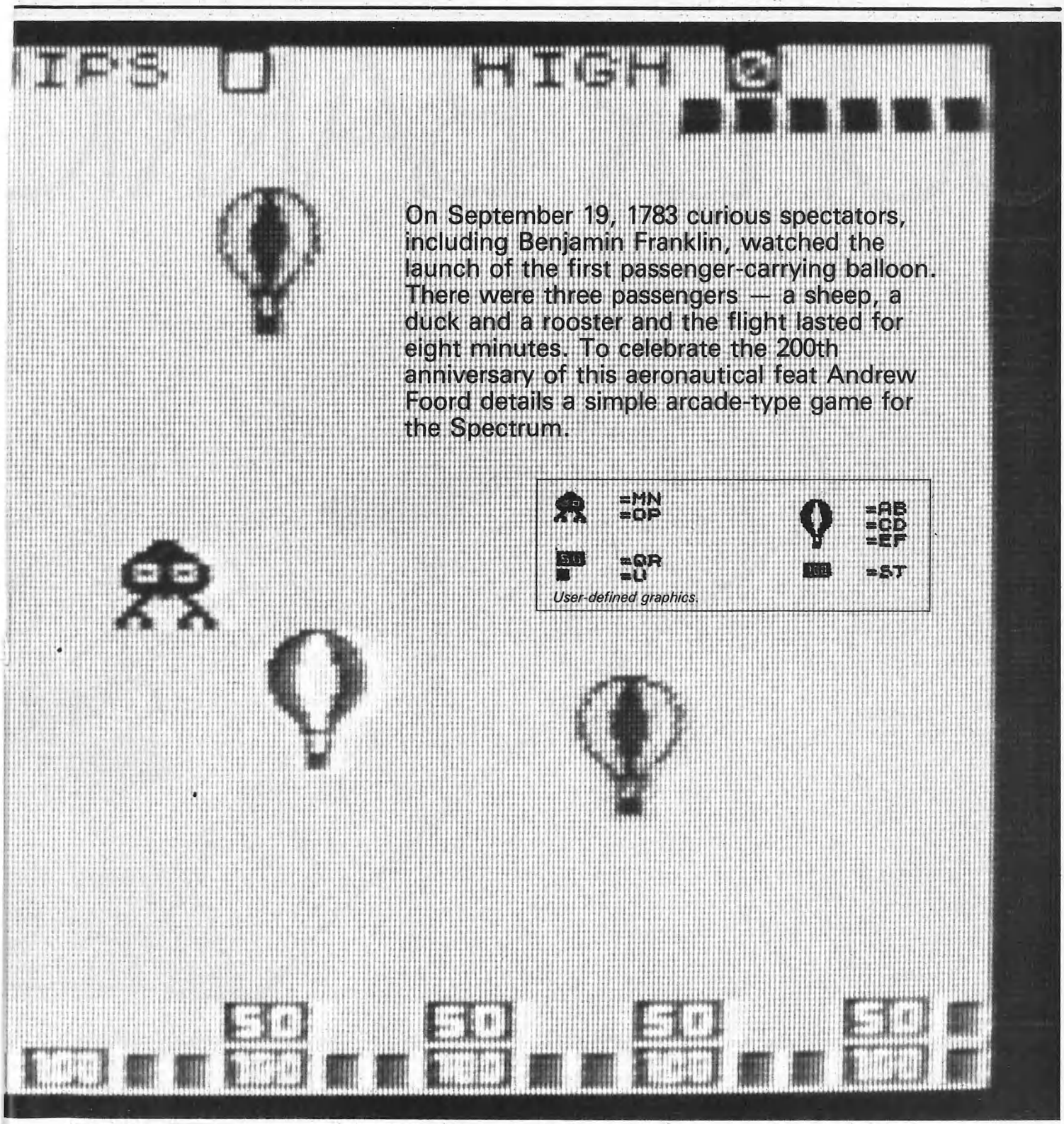
The program is written in Basic but contains a machine code routine which is Poked into memory from data statements when the program is first run. The machine code routine moves the balloons making the game much faster than if just using a Basic program. As the data is Poked into the memory the computer compiles a check-sum so, if you have made a typing error in the data statements, the computer should notice and warn you.

The program uses all 21 user-definable graphic characters and these are shown here. Graphics G to L do not appear in the listing because they are only used in the machine code, not the Basic part. The program is set out as follows:

- 5-110 Set up game
- 200-350 Set up screen
- 400-490 Main game routine
- 500-530 Cargo dropped
- 1000-1070 Life lost and end of game
- 2000-2090 Instructions
- 5000-5030 Poking in machine code and UDGs
- 7000-7095 UDG data
- 8000-8050 Machine-code data

To have more balloons at the start change Let Z=3 in line 100 to whatever you want. To have more than one extra balloon appear after a ship is fully loaded change line 527. To change the control keys change line 410. ■

```
   5 CLEAR 30999
  10 LET hs=0
  30 BRIGHT 0: OVER 0: INVERSE 0
  FLASH 0
  40 GO SUB 5000
  50 GO SUB 2000
  90 PAPER 7: INK 1: BORDER 1: C
LS
 100 LET s=0: LET z=3
 110 LET z$="■■■■"
 200 LET t$="": DIM a$(3,32)
 210 LET a$(2)="■■  ■■  ■■  ■■
■■  ■■  ■■  ■■■■"
 220 LET a$(3)="■■■■■■■■■■■■■■■■
■■■■■■■■■■■■■■■■"
 221 CLS : LET a=32000
 225 FOR f=1 TO z
 230 POKE a,INT (RND*29+1)
 240 POKE a+1,INT (RND*13+4)
 250 POKE a+2,INT (RND*3-1)
 260 POKE a+3,INT (RND*3-1)
 270 IF NOT PEEK (a+2) AND NOT P
EEK (a+3) THEN GO TO 250
 280 POKE a+4,INT (RND*3+2)+128*
(RND>.5)
 290 POKE a+5,255
 300 LET a=a+6
 305 NEXT f
 310 PRINT AT 0,0; PAPER 6;"SCOR
E";TAB 11;"SHIPS";TAB 22;"HIGH";
TAB 0;"■■■■■■";AT 1,26;"■■■■■■"
 315 PRINT INVERSE 1;AT 0,6;s;AT
 0,17;z$;AT 0,27;hs
 320 PRINT AT 20,0; INK 2;a$(2);
a$(3)
 330 LET x=15: LET y=2
 340 LET b$="": LET fl=0
 350 PRINT AT 1,6; INK 2;t$
 400 LET x1=x: LET y1=y
 410 LET x=x+(INKEY$="8")-(INKEY
$="5"): LET y=y+(INKEY$="6")-(IN
KEY$="7")
 415 LET x=x+(x=-1)-(x=31)
 420 LET c$=a$(1+(y+fl=19)+2*(y+
fl=20),x+1 TO x+2)
 440 LET y=y+(y=1)-(y+fl=21 OR (
y+fl>18 AND c$<>"  "))
 450 PRINT AT y1,x1;"  ";AT y1+1
,x1;"  "
 460 IF fl=1 THEN PRINT AT y1+2,
x1;"  "
 470 PRINT AT y,x;"■";AT y+1,x;
"■■": IF fl=1 THEN PRINT AT y+2,
x; INK 2;b$
 475 LET l=USR 31000
 476 IF ATTR (y,x)<>57 OR ATTR (
y+1,x)<>57 OR ATTR (y,x+1)<>57 O
R ATTR (y+1,x+1)<>57 THEN GO TO
1000
 480 IF fl=0 AND (c$(1)="■" OR c
$(1)="■") THEN BEEP .01,0: BEEP
.1,2: LET b$=c$: LET fl=1: LET a
$(y-16,x+1 TO x+2)="  "
 490 IF fl=0 OR y<>2 THEN GO TO
400
 500 LET fl=0: PRINT AT 4,x;"  "
 505 BEEP .01,4: BEEP .1,0: BEEP
.01,2
 510 LET t$=t$+b$: PRINT AT 1,6;
 INK 2;t$
 515 LET s=s+50+50*(b$(1)="■"):
PRINT AT 0,6; INVERSE 1;s
 520 IF LEN t$<20 THEN GO TO 400
 525 FOR f=1 TO 3: FOR g=0 TO 4:
BEEP .05,g: NEXT g: NEXT f
 526 LET s=s+200
 527 LET z=z+1
 530 GO TO 200
1000 LET z$=z$(2 TO ): PRINT AT
0,17; INVERSE 1;z$; INK 6;" "
1005 FOR f=6 TO 0 STEP -1: FOR g
=0 TO 9: BEEP .07,g+f: NEXT g: N
EXT f
1010 BEEP .1,-1: BEEP .1,-1
1030 IF z$<>"" THEN GO TO 221
1040 BEEP 1,0: BEEP 1,-1: BEEP 1
,-2
1050 IF s>hs THEN LET hs=s: PRIN
T AT 0,27; FLASH 1;hs
1060 PRINT AT 10,0; FLASH 1;"
GAME OVER    "; INVERSE 1;"    G
AME OVER    "
```



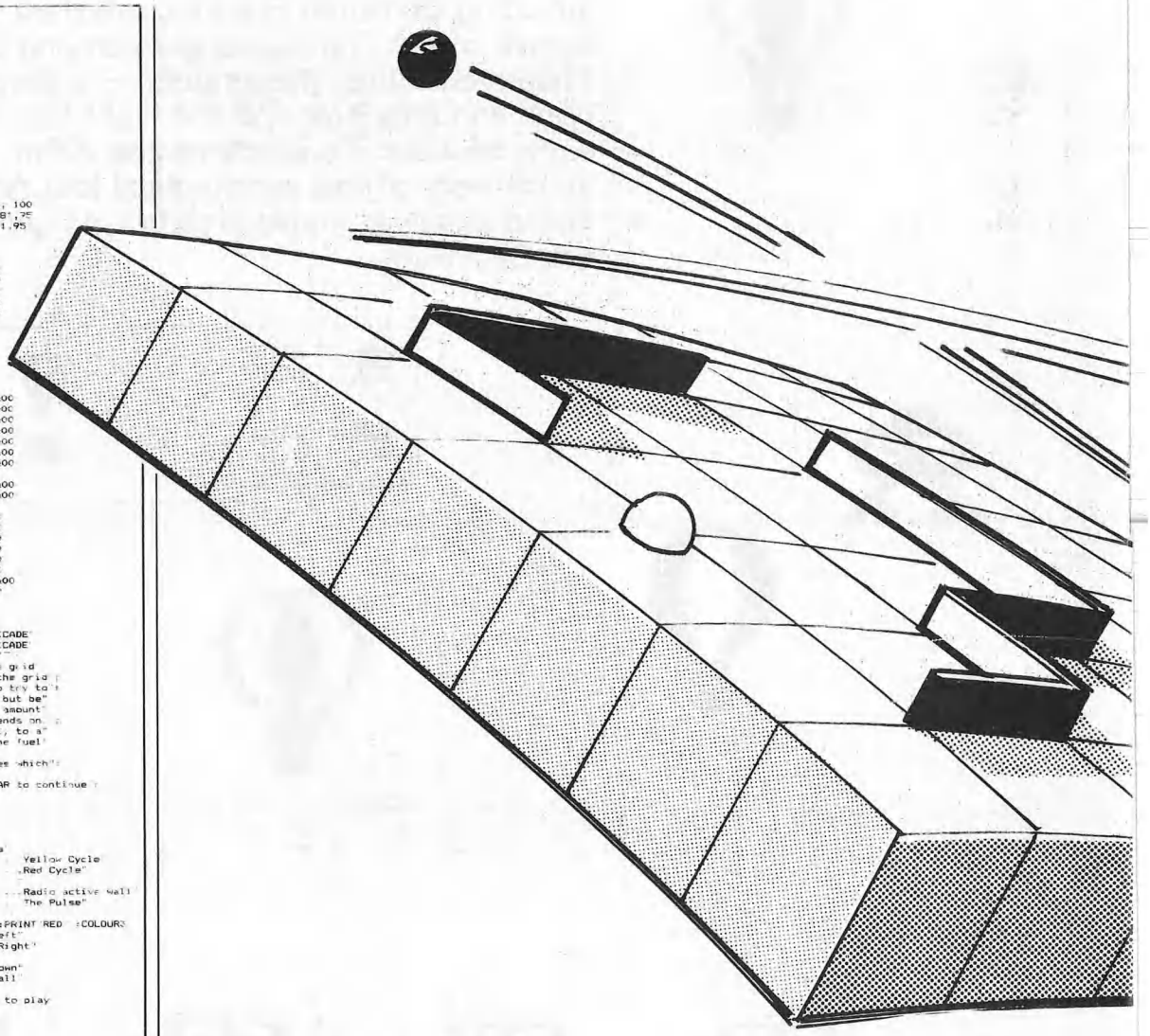
On September 19, 1783 curious spectators, including Benjamin Franklin, watched the launch of the first passenger-carrying balloon. There were three passengers — a sheep, a duck and a rooster and the flight lasted for eight minutes. To celebrate the 200th anniversary of this aeronautical feat Andrew Foord details a simple arcade-type game for the Spectrum.

```
1070 FOR f=1 TO 500: NEXT f: GO
TO 50
2000 BORDER 7: PAPER 7: INK 0: C
LS
2010 PRINT "This is:"'TAB 9; INK
 2;"BALLOON HOPPER"'TAB 9; INK
1;"© Andrew Foord"
2020 PRINT '" In this game you m
ust load the spacecraft at the t
op of screen with 10 pieces of c
argo from thespaceport."
2030 PRINT " Unfortunatly it is
air day and balloons will hinder
 you."
2040 PRINT '" Cargo
- Cargo -    Hopper   Balloon   50
pts   100pts"
2045 PRINT AT 15,3; INK 1;"▲";A
T 16,3;"▲▲"
2050 PRINT AT 15,11; INK 3;"▲";
AT 16,11;"▼▼";AT 17,11;"▼"
2055 PRINT AT 15,19; INK 2;"■
■"
2060 PRINT AT 18,0;"Controls-"
2070 PRINT '" Left    Down
Up    Right"; INK 2;"      5
  6       7          8"
2080 PRINT #0; PAPER 6;"      Pre
ss Any Key To Play";TAB 0
2085 IF INKEY$="" THEN GO TO 208
5
2090 RETURN
5000 PRINT AT 10,6;"PLEASE WAIT
A MOMENT"
5005 RESTORE : LET t=0: FOR f=US
R "a" TO USR "u"+7
5010 READ a: POKE f,a: LET t=t+a
: NEXT f
5015 FOR f=31000 TO 31178: READ
a: POKE f,a: LET t=t+a: NEXT f
5020 IF t<>38628 THEN PRINT "Err
or in Data": BEEP 1,0: STOP
5030 RETURN
7000 DATA 7,30,62,124,124,252,24
8,248,224,120,124,62,62,63,31,31
7010 DATA 248,248,248,124,124,60
,30,14,31,31,31,62,62,60,120,112
7020 DATA 6,7,2,2,2,3,3,3,96,224
,64,64,64,192,192,192
7030 DATA 7,25,33,67,67,131,135,
135,224,152,132,194,194,193,225,
225
7040 DATA 135,135,135,67,67,35,1
7,9,225,225,225,194,194,196,136,
144
7050 DATA 5,7,2,2,2,3,3,3,160,22
4,64,64,64,192,192,192
7060 DATA 0,3,7,31,63,97,109,97,
0,192,224,248,252,134,182,134
7070 DATA 127,63,13,24,48,120,20
4,204,254,252,176,24,12,30,51,51
7080 DATA 127,97,111,97,125,97,1
27,0,254,134,182,182,182,134,254
,0
7090 DATA 127,100,117,117,117,11
6,127,0,254,70,86,86,86,70,254,0
7095 DATA 0,126,126,126,126,126,
126,0
6000 DATA 221,33,0,125,221,126,0
,254,255,40,34,95,221,86,1,6,3,6
2,22,215,122,215,123,215,62,32,2
15,62,32,215
6010 DATA 20,16,240,221,35,221,3
5,221,35,221,35,221,35,24,215,22
1,33,0,125,221,126,0,254,255,200
,221,134,2,254,255,40,4,254,31,3
2,6,221
6020 DATA 126,2,237,68,221,119,2
,221,126,1,254,2,40,4,254,17,32,
8,221,126,3,237,68,221,119,3,221
,126,0,221,134,2,221,119,0,221,1
26,1,221
6030 DATA 134,3,221,119,1,14,144
,221,203,4,126,40,10,221,203,4,1
90,62,6,129,79,24,4,221,203,4,25
4,221,126
8040 DATA 4,203,191,198,56,50,14
3,92,221,86,1,6,3,62,22,215,122,
215,221,126,0,215,121,215,12,121
,215
8050 DATA 12,20,16,236,221,35,22
1,35,221,35,221,35,221,35,195,73
,121
```

SUPER BARRIC

Program 1.

```
10REM ***********************
20REM **  SUPER BARRICADE  **
30REM *   By Shingo Sugiura
40REM ***   (C)  JULY  83  ***
50REM ***********************
60
70PROCenv:PROCchars
80MODE7:PROCinst
90MODE1:PROCcast
100VDU26,1,31,30,29
110CHAIN"MAIN"
120
130DEFPROCenv
140ENVELOPE1,1,0,0,0,0,0,0,-1,-1,-1,1,126,100
150ENVELOPE2,1,96,-96,96,6,6,10,4,2,0,-1,81,25
160ENVELOPE3,1,6,-19,4,5,3,8,120,13,0,-3,81,95
170ENDPROC
180
190DEFPROCchars
200VDU23,218,130,130,130,130,254,226,226,226,0
210VDU23,219,128,128,128,224,224,224,254,0
220VDU23,220,136,136,136,254,226,226,226,0
230VDU23,221,138,138,138,234,234,234,254,0
240VDU23,222,254,128,128,248,224,224,224,0
250VDU23,224,24,66,0,153,153,0,66,24
260VDU23,225,0,0,120,255,255,120,0,0
270VDU23,226,0,0,30,255,255,30,0,0
280VDU23,227,24,60,60,60,60,24,24,24
290VDU23,228,24,24,24,60,60,60,60,24
300VDU23,229,24,24,24,255,255,24,24,24
310VDU23,230,36,36,255,36,36,255,36,36
320VDU23,231,&00,&66,&5A,&3C,&3C,&5A,&66,&00
330VDU23,232,&FE,&80,&80,&FE,&0E,&0E,&FE,&00
340VDU23,233,&FE,&80,&80,&E0,&E0,&E0,&FE,&00
350VDU23,234,&FC,&84,&84,&FE,&E2,&E2,&E2,&00
360VDU23,235,&FE,&80,&80,&FD,&E0,&E0,&FE,&00
370VDU23,236,&FE,&8A,&8A,&EA,&EA,&EA,&E2,&00
380VDU23,237,&7C,&44,&44,&FE,&E2,&E2,&E2,&00
390VDU23,238,254,32,32,56,56,56,56,0
400VDU23,239,&FE,&82,&82,&E2,&E2,&E2,&FE,&00
410VDU23,240,&38,&08,&08,&38,&38,&38,&38,&00
420VDU23,241,130,130,254,46,46,56,56,0
430VDU23,242,252,128,128,224,238,228,252,0
440VDU23,243,254,130,130,130,226,226,226,0
450VDU23,244,252,132,132,254,226,226,254,0
460VDU23,245,254,130,254,128,224,224,224,0
470VDU23,246,130,130,130,226,226,226,254,0
480VDU23,247,252,130,130,226,226,226,252,0
490VDU23,248,&FE,&82,&82,&FE,&0E,&0E,&FE,&00
500VDU23,249,130,130,130,226,226,226,124,0
510ENDPROC
520
530DEFPROCinst
540PRINTCHR$134;CHR$141TAB(12)"SUPER BARRICADE"
550PRINTCHR$134;CHR$141TAB(12)"SUPER BARRICADE"
560PRINT TAB(10)CHR$133"By Shingo Sugiura"
570PRINT"  Control your cycles around the grid
580PRINT"avoiding the walls or going off the grid
590PRINT"Release your radio active tail to try to
600PRINT"force your opponent off the grid but be"
610PRINT"cautious as this uses up a large amount"
620PRINT"of energy on which your life depends on."
630PRINT"You can replenish your fuel supply to a"
640PRINT"certain degree by driving over the fuel"
650PRINT"pods littered around the grid."
660PRINT"Of course watch out for the pulses which"
670PRINT"inhabit the grid."
680PRINT CHR$136CHR$131"   Press SPACE BAR to continue"
690REPEATUNTILGET=32
700ENDPROC
710
720DEFPROCcast:VDU19,3,6;0;17,2
730PRINTTAB(13)"SUPER BARRICADE"
740COLOUR1:PRINT TAB(12)"By Shingo Sugiura"
750COLOUR2:PRINT CHR$227;:COLOUR3:PRINT"      Yellow Cycle
760COLOUR1:PRINT CHR$227;:COLOUR3:PRINT      Red Cycle"
770PRINT CHR$231"  ...Fuel pod"
780COLOUR1:PRINT CHR$230;:COLOUR3:PRINT"  ...Radio active Wall
790COLOUR1:PRINT CHR$224;:COLOUR3:PRINT      The Pulse"
800PRINT "Controls -"
810COLOUR2:PRINT "YELLOW"TAB(20);:COLOUR1:PRINT"RED  :COLOUR2
820PRINT" Q      Left"TAB(20)"[      Left"
830PRINT" W      Right"TAB(20)"]      Right"
840PRINT" R      Up"TAB(20)"C.RIGHT  Up"
850PRINT" D      Down"TAB(20)"C.UP    Down"
860PRINT" Z      Wall"TAB(20)"DEL     Wall"
870COLOUR1:PRINT "Or use joysticks."
880COLOUR2:PRINT          Press SPACE BAR to play
890REPEATUNTILGET=32
900ENDPROC
```



FIRST THE good news. This game is original, fast, and has good graphics and sound. Now the bad news. It only works with O.S. 1.2, is hyper-long, and needs a second player.

The game involves two cycles – no, it is not Tron – on the electric grid. The grid is inhabited by creatures called Pulses and you must avoid these at all costs. At the beginning of each grid each player starts with 300 units of energy. This decreases with each move but there are fuel pods littered around the grid so that energy can be replenished. Each player can also release radio-active walls to gain bonus but this eats up energy and, of course, if you run out of energy you will be vapourised.

Each grid has a time limit and if both players are alive at the end of the time limit they will go onto a harder grid. If they are still alive at the end of five grids they will go onto the Death Grid to battle it out to the end. In this grid, each player will get 100 units of energy on top of the bonus earned in the previous grids. The radio-active tail is released automatically and continuously so the battle is unlikely to last for more than a few seconds.

The game can be played with keyboard as well as joysticks – ANH01 type is suitable.

Type in the first program then Save it under a name other than Main. Then type in the second program and Save this under the name Main. If you have the disc system simply type it in but do not run it. Save before running. When you want to play the game run the first program and this will reset page and allow the program to run but do not press Break as this will corrupt the program and Old will not bring the program back. Also with the disc system you must make the following adjustments:

```
110 *KEYOPAGE=&1100 MCHAIN"MAIN"
    M
120 *FX138,0,128
```

As I said earlier, this program will not work with OS before 1.2 but it is possible to convert the program to run on OS 0.1 if you put a lot of effort into it. Anyway the OS 1.2 is now readily available in shops so there is no excuse for hanging on to your bug-filled OS 0.1.

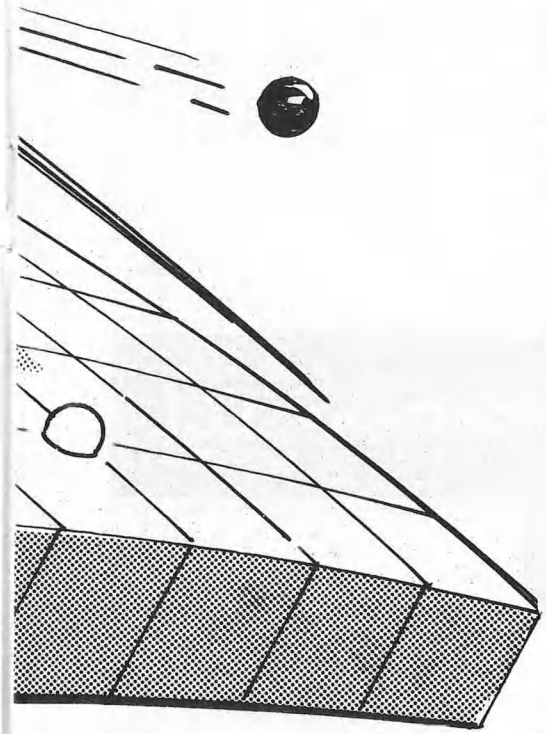
If you want to play the game but do not want to type in such a long program send a postal order or a cheque made payable to Shingo Sugiura for £3 to 42 Landford Road, Putney, London, SW15 1AG.

The game consists of two programs. The first program sets up the envelopes and defines the characters and prints the instructions. The second program is the game itself.

Line 10 ..... Selects mode 1 and asks players if they want joystick control or keyboard control.
Line 20 ..... Calls procedure to assemble short machine-code routine
Line 30 ..... Let grid equal 1

CADE

Watch out for the deadly pulses which inhabit the grid of this two-player game by Shingo Sugiura for the BBC Micro. The game can be played with keyboard or joysticks.



Line 60 . . . . . Calls procedure to initialise variables.
Line 70 . . . . . Calls procedure to print the grid.
Line 80 Sound at start of each grid.
Line 90 Reset time
Lines 100 to 230 . . Main program.
Lines 250 to 340 . . . Procedure to initialise variables.
Lines 360 to 410 . . . Checks keys for yellow cycle.
Lines 430 to 490 . . . Checks joystick1.
Lines 510 to 560 . . Checks keys for red cycle.
Lines 580 to 640 . . . . Checks joystick2.
Lines 660 to 870 . . . . Sets up the screen.
Lines 820 to 870 . . . . Prints an appropriate number of pulses.
Lines 890 to 970 . . . . Prints out the yellow cycle and also decides whether the tail should be printed.
Lines 990 to 1070 . . Prints the red cycle and also the tail if it should be.
Lines 1090 to 1140 . . Checks the next position of the yellow cycle.
Lines 1160 to 1210 . . Checks the next position of the red cycle.
Lines 1230 to 1300 . . The procedure called at the end of each grid.
Lines 1320 to 1340 . . Explosion.
Lines 1360 to 1460 . . Prints out the winner.
Lines 1480 to 1580 . . Main routine for the death grid.
Lines 1600 to 1690 . . Prepares players for the death grid.
Lines 1710 to 1760 . . Sets up variables necessary for the death grid.
Lines 1780 to 1850 . . Sets up the screen.
Lines 1870 to 1960 . . Prints out the yellow cycle.
Lines 1980 to 2070 . . Prints out the red cycle.
Lines 2090 to 2110 . . Death routine for the death grid.
Lines 2120 to 2290 . . Procedure to ask players if they would like joystick control or keyboard control.
Lines 2310 to 2380 . . Assemble a short machine code routine to find the character at the present cursor position.

Program 2.

```
  5 REM FOR £ READ HASH CHARACTER
 10MODE1:PROCoption
 20PROCass
 30grid=1
 40wall1%=0:wall2%=0
 50MODE1
 60PROCinit
 70PROCgrid
 80FORA=100TO130:SOUND&01,2,A,1:NEXT
 90TIME=0
100REPEAT
110IF A$="2" PROCkeys1:PROCkeys2
120IF A$="1" PROCjoy1:PROCjoy2
130but%=ADVAL(0)AND3
140PROCcheck1:PROCcheck2
150PROCcontrol1:PROCcontrol2
160VDU17,3,31,6,30:PRINT;2000-TIME;"  ";
170IF TIME>=2000 THEN time=0
180UNTIL flag1=0 OR flag2=0 OR time=0
190IF time=0 AND grid>4 PROCdeathgrid:GOTO230
200IF time=0 AND grid<=4 PROCnewgrid:GOTO50
210PROCexplode
220PROCnewgame
230GOTO30
240
250DEFPROCinit
260time=TRUE
270flag1=TRUE:flag2=TRUE
280X1=10:Y1=25
290X2=29:Y2=25
300x1inc=0:y1inc=-1
310x2inc=0:y2inc=-1
320energy1%=300:energy2%=300
330VDU23;10,32;0;0;0;
340ENDPROC
350
360DEFPROCkeys1
370IF INKEY(-17) x1inc=-1:y1inc=0:ENDPROC
380IF INKEY(-34) x1inc=1:y1inc=0:ENDPROC
390IF INKEY(-52) x1inc=0:y1inc=-1:ENDPROC
400IF INKEY(-51) x1inc=0:y1inc=1:ENDPROC
410ENDPROC
420
430DEFPROCjoy1
440A1%=ADVAL(1):A2%=ADVAL(2)
450IF A1%>=52000 x1inc=-1:y1inc=0:ENDPROC
460IF A1%<=12000 x1inc=1:y1inc=0:ENDPROC
470IF A2%>=52000 x1inc=0:y1inc=-1:ENDPROC
480IF A2%<=12000 x1inc=0:y1inc=1:ENDPROC
490ENDPROC
500
510DEFPROCkeys2
520IF INKEY(-73) x2inc=-1:y2inc=0:ENDPROC
530IF INKEY(-89) x2inc=1:y2inc=0:ENDPROC
540IF INKEY(-122) x2inc=0:y2inc=-1:ENDPROC
550IF INKEY(-58) x2inc=0:y2inc=1:ENDPROC
560ENDPROC
570
580DEFPROCjoy2
590B1%=ADVAL(3):B2%=ADVAL(4)
600IF B1%>=52000 x2inc=-1:y2inc=0:ENDPROC
610IF B1%<=12000 x2inc=1:y2inc=0:ENDPROC
620IF B2%>=52000 x2inc=0:y2inc=-1:ENDPROC
630IF B2%<=12000 x2inc=0:y2inc=1:ENDPROC
640ENDPROC
650
660DEFPROCgrid:VDU19,3,6;0,0:COLOUR3
670FOR I=3 TO 25:VDU31,1,I
680PRINTSTRING$(38,CHR$229):NEXT
690FORA=1TO10:PRINTTAB(RND(36)+2,RND(20)+5)CHR$231:NEXT
700VDU17,1,31,13,1,232,246,245,235,234,32,32
710VDU244,237,234,234,240,233,237,247,235
720VDU17,2,31,1,27,235,243,235,234,242,241,58:PRINT;energy1%
730VDU31,1,28,244,239,243,246,232,58:PRINT;wall1%
740VDU17,1,31,20,27,235,243,235,234,242,241,58:PRINT;energy2%
750VDU31,20,28,244,239,243,246,232,58:PRINT;wall2%
760VDU17,3,31,1,30,238,240,236,235,58:PRINT"2000"
770VDU31,20,30,242,234,240,247,32,grid+48
780PROCpulse
790VDU17,2,31,X1,Y1,227,17,1,31,X2,Y2,227
800ENDPROC
810
820DEFPROCpulse:COLOUR1
830FOR pul=1 TO grid*7+RND(grid*3)
840PRINTTAB(RND(36)+2,RND(20)+5)CHR$224
850NEXT
860VDU17,3,31,X1,Y1-1,229,31,X2,Y2-1,229
870ENDPROC
880
890DEFPROCcontrol1
900IF INKEY(-98) OR but%=1 OR but%=3 VDU17,2,31,X1,Y1,230:wall1%=wall1%+3:energ
y1%=energy1%-3:ELSE VDU17,3,31,X1,Y1,229
910VDU17,2:Y1=Y1+y1inc:X1=X1+x1inc
920VDU31,X1,Y1
930IFx1inc=1 VDU226 ELSEIF x1inc=-1 VDU225 ELSE IF y1inc=1 VDU228 ELSE VDU227
940energy1%=energy1%-1:PRINTTAB(8,27);energy1%;"  "
950PRINTTAB(7,28);wall1%;
960IF energy1%<=0 flag1=0
970ENDPROC
980
990DEFPROCcontrol2
1000IF INKEY(-90) OR but%=2 OR but%=3 VDU17,1,31,X2,Y2,230:wall2%=wall2%+3:energ
y2%=energy2%-3:ELSEVDU17,3,31,X2,Y2,229
1010VDU17,1:Y2=Y2+y2inc:X2=X2+x2inc
1020VDU31,X2,Y2
1030IFx2inc=1 VDU226 ELSEIF x2inc=-1 VDU225 ELSE IF y2inc=1 VDU228 ELSE VDU227
1040energy2%=energy2%-1:PRINTTAB(27,27);energy2%;"  "
1050PRINTTAB(26,28);wall2%;
1060IF energy2%<=0 flag2=0
1070ENDPROC
1080
1090DEFPROCcheck1
1100VDU31,X1+x1inc,Y1+y1inc:CALL code
1110IF ?&70=133 ENDPROC
1120IF ?&70<>135 flag1=0:ENDPROC
1130SOUND&02,2,100,5:energy1%=energy1%+10
1140ENDPROC
```

(listing continued on next page)

(listing continued from previous page)

```
1150
1160DEFPROCcheck2
1170VDU31,X2+x2inc,Y2+y2inc:CALL code
1180IF ?&70=133 ENDPROC
1190IF ?&70<>135 flag2=0:ENDPROC
1200SOUND&01,2,0,5:energy2%=energy2%+10
1210ENDPROC
1220
1230DEFPROCnewgrid:PRINTTAB(6,30);"0  "
1240FOR A=0TO80:SOUND&01,3,A,1
1250NEXT
1260grid=grid+1
1270VDU12,17,3,31,10,10,232,246,234,249,240,249,235,247,32
1280VDU242,234,240,247,32,grid+47
1290FOR A=1 TO 4000:NEXT
1300ENDPROC
1310
1320DEFPROCexplode
1330SOUND0,1,100,5
1340ENDPROC
1350
1360DEFPROCnewgame:FOR A=1 TO 3000:NEXT:CLS:*FX15,0
1370VDU31,8,9,238,239,246,242,218,32,219,246,233,220,32
1380IF flag1=0 VDU241,235,219,219,239,221,32,233,241,233,219,235 ELSE VDU234,23
5,247,32,233,241,233,219,235
1390VDU31,8,12
1400IF flag1=0 VDU234,235,247,32,233,241,233,219,235,32 ELSE VDU241,235,219,219
,239,221,32,233,241,233,219,235,32
1410VDU241,239,246,32,221,240,243
1420VDU31,10,15,241,239,246,32,242,239,238,32
1430VDU238,239,32,242,234,240,247,32,grid+48
1440PRINTTAB(6,20)"Press ";
1450VDU232,245,237,233,235,32,244,237,234,32:PRINT"to play"
1460REPEATUNTILGET=32:ENDPROC
1470
1480DEFPROCdeathgrid:PROCinfo
1490PROCinit2
1500PROCfingrid
1510FORA=100TO200:SOUND&01,2,A,1:NEXTA
1520REPEAT
1530PROCkeys1:PROCkeys2
1540PROCcycle1:PROCcycle2
1550UNTIL flag1=0 OR flag2=0
1560PROCdie
1570PROCnewgame
1580ENDPROC
1590
1600DEFPROCinfo
1610PRINTTAB(6,30);"0  "
1620FOR A=0TO100:SOUND&01,3,A,1
1630NEXT
1640VDU12,17,3,31,10,10,232,246,234,249,240,249,235,247
1650VDU32,242,234,240,247,32,grid+48
1660VDU17,2,31,7,20,245,234,235,245,237,234,235,32,222,239,234,32
1670VDU247,235,237,238,218,32,242,234,240,247
1680FOR A=1 TO 4000:NEXT
1690ENDPROC
1700
1710DEFPROCinit2
1720flag1=TRUE:flag2=TRUE
1730X1=10:Y1=25:X2=29:Y2=25
1740x1inc=0:y1inc=-1:x2inc=0:y2inc=-1
1750energy1%=100+wall1%:energy2%=100+wall2%
1760ENDPROC
1770
1780DEFPROCfingrid:VDU12,19,3,5;0;17,3
1790FOR I=3 TO 25:VDU31,1,I
1800PRINTSTRING$(38,CHR$229):NEXT
1810VDU17,1,31,13,1,247,235,237,238,218,32,242,234,240,247
1820VDU17,2,31,1,27,235,243,235,234,242,241,58:PRINT;energy1%
1830VDU17,1,31,20,27,235,243,235,234,242,241,58:PRINT;energy2%
1840VDU17,2,31,X1,Y1,227,17,1,31,X2,Y2,227
1850ENDPROC
1860
1870DEFPROCcycle1
1880VDU31,X1+x1inc,Y1+y1inc:CALL code
1890IF ?&70<>133:flag1=0:ENDPROC
1900VDU17,2,31,X1,Y1,230
1910X1=X1+x1inc:Y1=Y1+y1inc
1920VDU31,X1,Y1
1930IFx1inc=1 VDU226 ELSEIF x1inc=-1 VDU225 ELSEIF y1inc=1 VDU228 ELSE VDU227
1940energy1%=energy1%-1:PRINTTAB(8,27);energy1%;"  "
1950IF energy1%<=0 flag1=0
1960ENDPROC
1970
1980DEFPROCcycle2
1990VDU31,X2+x2inc,Y2+y2inc:CALL code
2000IF ?&70<>133 flag2=0:ENDPROC
2010VDU17,1,31,X2,Y2,230
2020X2=X2+x2inc:Y2=Y2+y2inc
2030VDU31,X2,Y2
2040IFx2inc=1 VDU226 ELSEIF x2inc=-1 VDU225 ELSEIF y2inc=1 VDU228 ELSE VDU227
2050energy2%=energy2%-1:PRINTTAB(27,27);energy2%;"  "
2060IF energy2%<=0 flag2=0
2070ENDPROC
2080
2090DEFPROCdie:SOUND0,1,100,5
2100FORA=255TO100STEP-1:SOUND&01,3,A,1:NEXT
2110ENDPROC
2120DEFPROCoption
2130VDU17,1,31,13,1,232,246,245,235,234,32,32
2140VDU244,237,234,234,240,233,237,247,235,17,2
2150PRINT'''TAB(12)"By Shingo Sugiura":COLOUR3
2160PRINT'''"  You have the option of using the"
2170PRINT"keyboard or the ANHOI joysticks to"
2180PRINT"control your cycles."
2190PRINT''"If using joysticks, yellow cycle is"
2200PRINT"controlled by joystick1 and the red"
2210PRINT"cycle is controlled by joystick2.":COLOUR2
2220PRINT''"1 .Joystick control"
2230PRINT'"2 .Keyboard control"
2240COLOUR1:PRINT''"Which option? ";
2250REPEAT:A$=INKEY$(10):UNTIL A$="1" OR A$="2"
2260PRINT;A$:COLOUR3
2270PRINT'"  Press SPACE BAR to enter grid";
2280REPEAT UNTIL GET=32
2290ENDPROC
2300
2310DEFPROCass:OSBYTE=&FFF4
2320DIM code 10
2330P%=code
2340[OPT 0
2350LDA£135:JSR OSBYTE
2360STX&70
2370RTS:]
2380ENDPROC
```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A bug tracer on your Spectrum can save time and end frustration. Gary Rees explains how to add this feature.

"But how did you deduce that there was a bug in line 400, Holmes?"

DEBUGGING YOUR PROGRAMS

Listing 1.

```
0001      (C) GARRY REES 1983.
          --------------------
          MEMORY LEFT,TRACE AND SPEED ROUTINES.

5         FE69              ORG  65129
69        00                NOP
70        00                NOP
71        FF                RST  38H
85        F3          L5:   DI

DISABLE  FURTHER  INTERRUPTS
-----------------------------
90        C5                PUSH  BC
110       D5                PUSH  DE
130       E5                PUSH  HL
150       F5                PUSH  AF

STACK REGISTER VALUES FOR RETURN
--------------------------------
170       01FEBF            LD    BC,49150

INITIALISE 'BC' READY FOR KEYBOARD READ
---------------------------------------
190       ED78              IN    A,(C)

READ KEYBOARD
-------------
210       FEFC              CP    0FCH
IS 'ENTER' AND 'L' BEING PRESSED?
---------------------------------
230       281C              JR    Z,L2

IF YES THEN GOTO L2
-------------------
235       FEFA              CP    0FAH

IS 'ENTER' AND 'K' BEING PRESSED?
---------------------------------
237       280A              JR    Z,ON
238       FEF6              CP    0F6H
239       200B              JR    NZ,TEST

IF 'ENTER' AND 'J' IS BEING PRESSED THEN
 SWITCH TRACE FLAG OFF
----------------------
243       AF                XOR   A

ZERO THE ACCUMULATOR
--------------------
245       329DFE            LD    (FLAG),A
250       1805              JR    TEST
255       3E01        ON:   LD    A,1
260       329DFE            LD    (FLAG),A

SWITCH 'TRACE' FLAG ON
----------------------
265       CDB5FE      TEST: CALL  L3

CALL THE MAIN ROUTINE
---------------------
270       F1          UNSTK: POP  AF
290       E1                 POP  HL
310       D1                 POP  DE
320       C1                 POP  BC

RESTORE ORIGINAL REGISTER VALUES.
---------------------------------
```

(listing continued on page 85)

USING MACHINE CODE you can add some useful features to your Spectrum but there is often the disadvantage that the routines may have to be called many times using commands like Randomise and USR. One way of overcoming this problem is to use interrupts to call your code automatically.

If you want to use more than one routine, however, there is the problem of switching between routines, that is turning each one off and on as and when desired. This problem can be overcome by using a combination of key presses to switch routines without having to stop any Basic program that may also be running.

I use the Enter key as an extra Shift key. It still works as normal but if it is held down and another key is pressed this will signal the routine which utility I want turned on. I decided to use interrupts to give my Spectrum some of the features found on other computers.

(continued on page 85)

AGF

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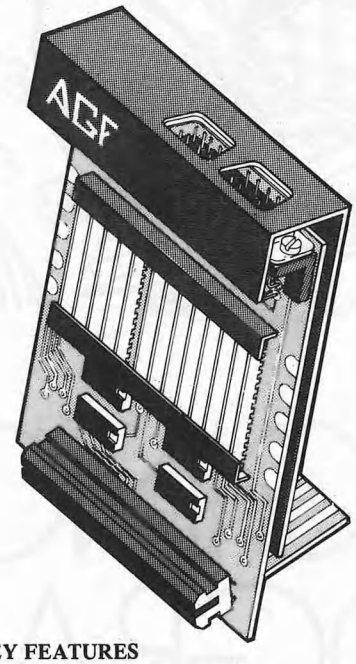

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- One pack of ten Quick Reference Programming Cards for at-a-glance setting to your games requirements. The card allows you to mark the configuration in an easy to read fashion with space to record the software title and company name.
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(listing continued from page 83)

```
350     FB                  EI

RE-ENABLE FOR NEXT INTERRUPT.
-----------------------------
370     C9                  RET
390     CDAAFE      L2:     CALL  STOP
400     18F5                JR    UNSTK

SWITCH ROUTINE OFF FROM KEYBOARD.
---------------------------------
560     00                  NOP
570     00                  NOP
610     00                  NOP
620     00                  NOP
670     3E09                LD    A,9
690     ED47                LD    I,A
710     ED5E                IM2
730     C9                  RET

DIVERT INTERRUPTS TO MY ROUTINE.
--------------------------------
750     00                  NOP
760     00                  NOP
770     00                  NOP
800     3E3E        STOP:   LD    A,03EH
810     ED47                LD    I,A
820     ED56                IM1
830     C9                  RET

RESTORE INTERRUPT VECTOR REGISTER TO NORMAL.
--------------------------------------------
START OF MAIN ROUTINE.
----------------------
840     00                  NOP
850     00                  NOP
860                 FLAG:   DEFB  00H
990                 SCN:    DEFW  20671

ADDRESS OF DISPLAY IN DISPLAY FILE.
-----------------------------------
1030    ED5B655C    L3:     LD    DE,(23653)
1035    21BF50              LD    HL,20671
1036    22B3FE              LD    (SCN),HL

RESTORE DISPLAY FILE ADDRESS.
-----------------------------
1038    3A9DFE              LD    A,(FLAG)
1039    FE01                CP    1
1040    CC25FF              CALL  Z,DEL

IF 'TRACE' FLAG ON THEN CALL 'TRACE' AND 'SPEED'.
-------------------------------------------------
1042    2005                JR    NZ,L14

OTHERWISE CALL 'MEMORY LEFT' ROUTINE.
-------------------------------------
1044    2A455C              LD    HL,(23621)
1046    1809                JR    L13
1048    CD051F      L14:    LD    HL,(23730)
1056    ED52                SBC   HL,DE

FIND OUT HOW MUCH MEMORY IS LEFT.
---------------------------------
1060    01F0DB      L13:    LD    BC,-10000
1070    CDF5FE              CALL  SR2
HOW MANY 'TEN THOUSANDS' OF BYTES ARE THERE?
--------------------------------------------
1100    011BFC              LD    BC,-1000
1103    CDF2FE              CALL  SR2

HOW MANY 'THOUSANDS' OF BYTES ARE THERE?
----------------------------------------
1105    019CFF              LD    BC,-100
1107    CDF2FE              CALL  SR2

HOW MANY 'HUNDREDS' ARE THERE?
------------------------------
1108    01F6FF              LD    BC,-10
1109    CDF2FE              CALL  SR2
1110    01FFFF              LD    BC,-1
1111    CDF2FE              CALL  SR2

HOW MANY 'TENS' AND 'ONES' ARE THERE?
-------------------------------------
1113    C9                  RET

1115    AF          SR2:    XOR   A
1117    09          LA1:    ADD   HL,BC
1125    3C                  INC   A
1130    38FC                JR    C,LA1
1135    ED42                SBC   HL,BC
1150    3D                  DEC   A

THE ABOVE ROUTINE CALCULATES EACH DIGIT
---------------------------------------
1170    C630                ADD   A,30H

AND CONVERTS IT TO ASCii
------------------------
1172    E5                  PUSH  HL
1175    CD0CFF              CALL  SR
1177    21B3FE              LD    HL,SCN
1179    34                  INC   (HL)

INCREASE SCREEN ADDRESS READY FOR NEXT DIGIT
--------------------------------------------
1181    2AB3FE              LD    HL,(SCN)
1183    CD19FF              CALL  L7
1185    E1                  POP   HL
1190    C9                  RET

1233    ED4B365C    SR:     LD    BC,(23606)
1250    2600                LD    H,0
1270    6F                  LD    L,A
1290    29                  ADD   HL,HL
1300    29                  ADD   HL,HL
1310    29                  ADD   HL,HL
1330    09                  ADD   HL,BC
1340    EB                  EX    DE,HL
1350    C9                  RET

THE ABOVE ROUTINE FINDS THE ADDRESS OF THE
CHARACTER IMAGE IN THE CHARACTER TABLE
--------------------------------------
1400    0608        L7:     LD    B,8
1410    1A          L8:     LD    A,(DE)
1440    77                  LD    (HL),A
1460    24                  INC   H
1480    13                  INC   DE
1500    10FA                DJNZ  L8
1520    C9                  RET

THIS WILL 'PRINT' A DIGIT ON THE SCREEN
---------------------------------------
1600    060A        DEL:    LD    B,10
1620    C5          D2:     PUSH  BC
1630    01F401              LD    BC,500
1650    210000              LD    HL,0000
1660    110000              LD    DE,0000
1680    EDB0                LDIR
1700    C1                  POP   BC
1710    10F1                DJNZ  D2
1720    C9                  RET

SPEED ROUTINE TO DELAY RETURN
-----------------------------
9999                        END
```

(continued from page 83)

The first of these is a constant display of how much memory is left, whether you are running a Basic program or just entering a line of Basic.

The current position of RAMtop is of course taken into account and if you are entering a line the free memory can be seen to decrease as each keyword or character is typed. When running a program the free memory decreases as each variable is assigned.

The second feature I decided to add is Trace. This displays the number of the line currently being executed by Basic and is useful for debugging programs and following the program flow.

A slight problem arises here though. The lines of Basic are read and interpreted so quickly that following the program flow becomes difficult for us humans. For this reason I have added a third feature, Speed. This simulates slowing the processor down to one of 256 different speeds and, as well as being useful in this application, can also be used to vary the speed of games to suit personal taste. Note, however, that listings and keyboard reads are slowed.

The speed may be varied by Poking location 65315, on the 48K version, with a number between 1 and 255. A value of 1 slows program execution down only slightly and will be hardly noticeable, a value of 255 is very very slow and should be used with caution as the keyboard is then read only every few minutes and keys will have to be held down until they are read. Poking with zero has a similar effect to Poking with 255.

The program itself starts at 65129 but is switched on initially by entering Randomise USR 65183. This turns on the Memory Left routine. If Enter is held down and K is pressed then Trace and Speed are switched on. This will display 65534 until it is actually used. If Enter and J are pressed then Speed and Trace are off and Memory Left is on.

The program can be turned off completely by holding down Enter and pressing L or by entering Randomise USR 65193.

Switching on changes the interrupt vector register to point to the machine-code program and the program is then called up to 50 times a second depending upon the value of Speed. The value of Memory Left or Current Line Number is displayed on line 23 of the screen just above the normal K cursor position but this can be changed to any part of the screen if you prefer by Poking locations 65210 and 65211 with the display file address you want. For example, to change the display to 16384 — line 0, column 0:

Poke 65211, INT(16384/256).
Poke 65210, 16384 – 256*INT(16384/256)

Interrupts are disabled during Loading and Saving and so the machine-code program will stop temporarily but will recommence when the Load etc, is complete.

The program was written for a 48K Spectrum using an assembler and is stored above RAMtop to prevent it being overwritten by Basic variables. If you have an assembler then simply enter listing 1, Save the object code on tape, type Clear 65128 and re-load the code. On typing Randomise USR 65183 the free memory should appear on line 23. If it does not then check your assembler listing carefully.

For those using 16K and an assembler the following changes have to be made:

Line 5 becomes	ORG	32348
Line 670 becomes	LD	A,40

If you do not have an assembler enter the appropriate Basic listing. Remember to Save the machine code on tape before switching the routine on, just in case you make a mistake when entering the data.

The 16K version is switched on by typing Randomise USR 32402. The Speed adjuster is at location 32534 and the display position can be altered by Poking locations 32429 and 32430.

Save the 16K version with

SAVE "MEM"CODE 32384,203

or the 48K with

SAVE "MEM"CODE 65129,203 ■

Listing 2.

```
5   REM ©GARRY REES 1983
6   REM 16K VERSION
10  CLEAR 32347
20  FOR F= 32348 TO 32550
30  READ N:POKE F,N
40  NEXT F
50  STOP
110 DATA 0,0,255,243,197,213,2
29,245,1,254
120 DATA 191,237,120,254,252,4
0,28,254,250,40
130 DATA 10,254,246,32,11,175,
50,165,126,24
140 DATA 5,62,1,50,165,126,205
,168,126,241
150 DATA 225,209,193,251,201,2
05,156,126,24,245
160 DATA 0,0,0,0,62,40,237,71,
237,94
170 DATA 201,0,0,0,62,62,237,7
1,237,86
180 DATA 201,0,0,0,191,80,237,
91,101,92
190 DATA 33,191,80,34,166,126,
50,165,126,254
200 DATA 1,204,21,127,32,5,42,
69,92,24
210 DATA 5,42,178,92,237,82,1,
240,216,205
220 DATA 229,126,1,24,252,205,
229,126,1,156
230 DATA 255,205,229,126,1,246
,255,205,229,126
240 DATA 1,255,255,205,229,126
,201,175,9,60
250 DATA 56,252,237,66,61,198,
48,229,205,255
260 DATA 126,33,166,126,52,42,
166,126,205,12
270 DATA 127,225,201,237,75,54
,92,38,0,111
280 DATA 41,41,41,9,235,201,6,
8,26,119
290 DATA 36,19,16,250,201,6,10
,197,1,244
300 DATA 1,33,0,0,17,0,0,237,1
76,193
310 DATA 16,241,201
```

Arcade Action For The ZX Spectrum

Protek ZX Spectrum Joystick Interface £14·95

The Protek Joystick interface allows games to be controlled with a joystick. Works with any game which uses the cursor control keys for movement and Ø for fire.

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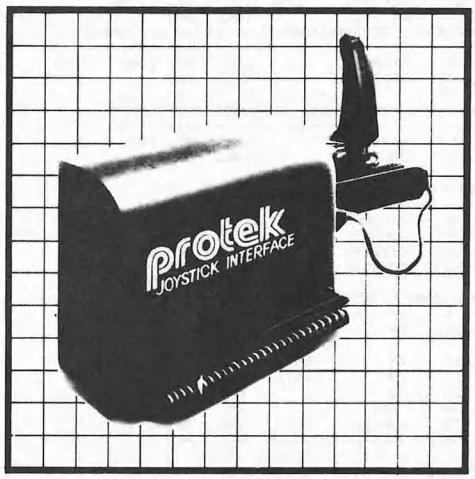

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DK 'Tronics	3D Tanx, Meteoroids	**Silversoft**	Ground Attack, Cyber Rats
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Leap out of trouble with Brian Lewis's Frogger.

THIS GAME IS WRITTEN for the 48K Oric although I see no reason why it should not be run on the 16K machine.

The game follows the normal Frogger scenario. You, the frog, have to work your way up the screen. First, you must dodge oncoming cars and lorries, then you have to jump on the passing logs in the upper part of the display. To move forward press A, to move left press N and to go right press M. Once you reach the top row you must jump into one of the five froggy homes. Once all five homes are filled you progress to the next sheet. Getting hit by a car or lorry, missing a log, or home will result in one of your three lives being lost.

The colours in the program can be changed by listing lines 20 to 30, and changing the escape characters. The main display may also be altered by listing lines 1000 to 1010. If the user-defined graphics are not to your liking then these are contained between lines 1010 and 2000. The sub-routines 6000 and 7000 check for loss of life and arrival at a home. Lines 80 to 90 keep the logs and vehicles scrolling smoothly and should not be tampered with. Scoring is as follows: 10 points for every jump forward; 100 points for every screen completed.

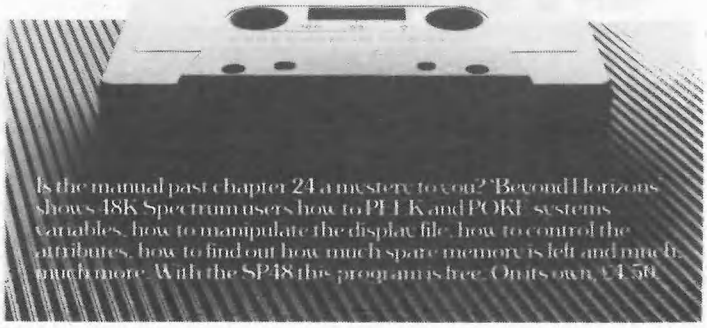
If the game becomes too easy then reduce the For-Next loop in line 50 or take out either left or right movement.

The small machine-code sub-routine at the beginning of the program is necessary because of the method of scrolling the logs and vehicles. It was borrowed from the chapter on machine code in the Oric manual.

```
0 LIVES=3:REM FOR £ READ HASH CHARACTER
1 CLS
2 REPEAT
3 READD
4 POKE£400+C,D
5 C=C+1:UNTIL D=£FF
6 DATA£20,£96,£D9,£AC,£F8,£02,£CB,£8C,£69,£02,£A5,£1F,
£A4,£20,£85,£12,£84,£13
7 DATA£A9,£3B,£20,£DB,£CF,£4C,£61,£CB,£FF
8 DOKE£2F5,£400
9 GOSUB1000
11 A$(1)="o[[[[p                    o[[[[p
o[[[[p
     "
12 A$(2)="u[[i            u[[i            u[[i            u[
[i           u
[[i        "
13 A$(3)="   o[[[p                o[[[p                o
[[[p
    "
14 A$(4)="u[[[[i             u[[[[i             u[[[[i
          u[[
[[i"
15 A$(5)="qw          [[[[[y       qw          [[[[[y
 qw          [
[[[[y  "
16 A$(6)="er       er       t[[[[[       er       er
t[[[[[       e
r       er"
17 A$(7)="[[[[[y       qw       qw       [[[[[y       qw
      qw
  [[[[[y"
18 A$(8)="er       er       er       er       er       er
    er       er       er  "
19 D=30:C=1:C1=1:D1=30:Z=30:Z1=30:V=1:V1=1:A=9:B=23:Z$
=" "
20 !0,3;CHR$(27);"@";MID$(A$(1),D,35);
21 !0,9;CHR$(27);"@";MID$(A$(2),C,35);
22 !0,7;CHR$(27);"@";MID$(A$(3),D1,35);
23 !0,5;CHR$(27);"@";MID$(A$(4),C1,35);
24 !0,13;CHR$(27);"B";MID$(A$(5),Z,35);
25 !0,15;CHR$(27);"C";MID$(A$(6),V,35);
26 !0,17;CHR$(27);"B";MID$(A$(7),Z1,35);
27 !0,19;CHR$(27);"C";MID$(A$(8),V1,35);
28 PLOT1,26,"SCORE:":PLOT7,26,STR$(S)
29 PLOT30,26,"LIVES:":PLOT37,26,STR$(LIVES)
30 PLOT13,26,"HI-SCORE:":PLOT22,26,STR$(HS)
31 IF B<10 THEN Z$=CHR$(SCRN(A,B)) ELSE Z$=" "
32 K$=KEY$
33 IF K$="N" AND A>1 THEN PLOTA,B,Z$:A=A-1
34 IF K$="A" THEN PLOTA,B,Z$:B1=-2:L=1
35 IF K$="M" AND A<37 THEN PLOTA,B,Z$:A=A+1
36 IF B1=-2 THEN S=S+10:PING
39 A=A+A1:B=B+B1:IF B=1 THEN 6000
40 IF B>12 THEN 47
41 IF B=11 THEN 50
42 IF SCRN(A,B)=32 THEN 7000
43 IF L=1 THEN 50
44 IF B=5 OR B=9 THEN A=A-1:PLOTA,B,"]"
45 IF B=3 OR B=7 THEN A=A+1:PLOTA,B,"]"
46 GOTO50
47 IF B=23 OR B=21 THEN 50
48 IF SCRN(A,B)<>32 THEN 7000
24 FORN=1TO2:PLOTA,B,"]":NEXTN
50 FORN=1TO2:PLOTA,B,"]":NEXTN
```

(continued on page 89)

Extend your 16k Spectrum to 48k for just £23·00. And get a Free program worth £4·50 into the bargain.



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EAST LONDON ROBOTICS

(continued from page 87)

```
60 IF A<=2 OR A>=37 THEN 6001
80 D=D-1:C=C+1:D1=D1-1:C1=C1+1:Z=Z-1:Z1=Z1-1:V=V+1:V1=
V1+1
82 IF D=5 THEN D=27
83 IF C=15 THEN C=1
84 IF D1=5 THEN D1=25
85 IF C1=23 THEN C1=5
86 IF Z=5 THEN Z=28
87 IF Z1=5 THEN Z1=34
88 IF V=30 THEN V=2
89 IF V1=35 THEN V1=4
90 B1=0:A1=0:L=0:GOTO20
1000 LORES0:PAPER0:INK7:POKE618,10:CLS
1001 FORA=0TO7:POKE46080+A+(8*ASC("[")),63:NEXTA
1002 FORT=0TO1:PRINT"[[[   [[[[   [[[[   [[[[   [[[[
 [[[":NEXTT
1003 FORN=1TO9:PRINTCHR$(27);"T":NEXTN
1004 FORN=1TO2:PRINTCHR$(27);"Q":NEXTN
1005 FORT=1TO8:PRINT:NEXTT
1006 FORT=0TO2:PRINTCHR$(27);"U":NEXTT:IF K=1 THEN RET
URN
1007 FORA=0TO7:READD:POKE46080+A+(8*ASC("q")),D:NEXTA
1008 DATA0,7,8,16,63,63,20,8
1009 FORA=0TO7:READD:POKE46080+A+(8*ASC("w")),D:NEXTA
1010 DATA0,0,32,16,62,63,10,4
1011 FORA=0TO7:READD:POKE46080+A+(8*ASC("e")),D:NEXTA
1012 DATA0,0,1,2,31,63,20,8
1013 FORA=0TO7:READD:POKE46080+A+(8*ASC("r")),D:NEXTA
1014 DATA0,56,4,2,63,63,10,4
1015 FORA=0TO7:READD:POKE46080+A+(8*ASC("t")),D:NEXTA
1016 DATA0,6,62,~2,62,62,6,0
1017 FORA=0TO7:READD:POKE46080+A+(8*ASC("y")),D:NEXTA
1018 DATA0,24,31,31,31,31,24,0
1019 FORA=0TO7:READD:POKE46080+A+(8*ASC("u")),D:NEXTA
1016 DATA3,7,9,9,9,9,7,3
1021 FORA=0TO7:READD:POKE46080+A+(8*ASC("i")),D:NEXTA
1022 DATA0,32,48,48,48,48,32,0
1023 FORA=0TO7:READD:POKE46080+A+(8*ASC("p")),D:NEXTA
1024 DATA48,56,36,36,36,36,56,48
1025 FORA=0TO7:READD:POKE46080+A+(8*ASC("o")),D:NEXTA
1026 DATA0,1,3,3,3,3,1,0
1027 FORA=0TO7:READD:POKE46080+A+(8*ASC("]")),D:NEXTA
1028 DATA0,12,30,45,63,12,30,33
1999 RETURN
6000 IF SCRN(A-1,B)<>91 AND SCRN(A+1,B)<>91 THEN 6010
6001 IF B=1 THEN  Z$=CHR$(SCRN(A,B-1)) ELSE Z$=" "
6002 PLOTA,B,"]":WAIT50
6004 PLAY7,0,0,0:GOTO7001
6010 PLOTA-1,B,"[[[":ZAP:B=23
6011 A=RND(1)*34+2
6020 H=H+1:IF H=5 THEN H=0:GOTO10000
6025 GOTO20
7000 PLAY7,0,0.0:PLOTA,B,"]":Z$=" "
7001 FORN=12TO1STEP-1
7002 MUSIC1,1,N,15
7003 MUSIC2,2,N,15
7004 MUSIC3,3,N,15
7005 WAIT10:NEXTN
7006 PLAY0,0,0,0
7007 LIVES=LIVES-1
7008 PLOT30,26,"LIVES:":PLOT37,26,STR$(LIVES)
7009 PLOTA,B,Z$:B=23:A=RND(1)*34+2:Z$=" ":K$=" ":IF LI
VES<>0 THEN 2
0
7011 CLS
7012 PRINT"YOU SCORED:";S
7013 IF HS<S THEN ZAP:WAIT50:GOTO9000
7014 PRINT"HIGH SCORE HELD BY:";B$
7015 PRINT"WITH A GREAT SCORE OF:";HS
7016 PRINT"ANOTHER GO ?"
8000 K$=KEY$:IF K$="" THEN 8000
8096 GOTO9009
8002 END
9000 CLS
9001 PRINT
9002 PRINTCHR$(4);CHR$(27);"Q";CHR$(27);"N          A NE
W HIGH SCORE
!"
9003 PRINTCHR$(4)
9004 PRINTCHR$(6);CHR$(17)
9005 INPUT"ENTER IN YOUR NAME ";B$
9006 IF LEN(B$)>7 THEN PRINT"TOO LARGE !":GOTO9005
9007 PRINT"OK ";B$;" ANOTHER GO ?"
9008 K$=KEY$:IF K$="" THEN 9008
9009 IF K$="Y" THEN LIVES=3:K=1:HS=S:S=0:GOTO9
9010 END
10000 FORT=0TO1:PLOT1,T,"[[[   [[[[   [[[[   [[[[   [[
[[   [[[":NEX
TT
10001 S=S+100:FORN=0TO2
10002 ZAP:WAIT5:NEXTN
10003 GOTO20
```


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VIC GOLF CH

Ray and Stephen Nolan tee off our golf double with a game for the Vic-20 with 8K or 16K expansion. Vikki Allsop follows through with her version of the game for an unexpanded Vic.

AT LAST HERE is a game for the Vic-20 with 8K/16K expansion, although only 6.5K long, it could therefore be converted for the +3K system. This game does not tie your fingers in knots but gives you time to think before making mistakes! Ideal for the fair weather golfer or non-player, it provides a full choice of clubs and options of fade or draw — right or left swings — for long shot positioning to avoid the random generated traps of bunkers, trees and water hazards.

Although the 18 hole course is provided each hole is randomly generated to give a new design each round. The clubs are selected to achieve distance as follows:

Keys	Keys
1 to 4 for woods	1 to 4 for distance 200-280 yards
11 to 16 for irons	1 to 6 for distance 100-200 yards
17 to 19 for irons	7 to 9 for distance 0-100 yards

Clubs 1 and 2 can be played off line by entering F or D, and the strength of 3 entered as a percentage. Putting is self explanatory by entering any decimal number between 1 and 13.

Initially the player can select his or her own handicap and one fault which may affect the run of play. Extensive use of the pre-defined key graphics is made and further colour refinements can be added but for use on a monochrome monitor a clear contrast is used for the graphic display.

Expanded golf game listing.

```
10 POKE36879,59
20 PRINT"♥"
30 PRINT"          GOLF"
40 PRINT"          ────"
50 PRINT"■■■■■■BY RAY & STEPHEN"
60 PRINT"          NOLAN"
70 PRINT"■■    COPYRIGHT 1983 "
80 PRINT"■■■■■■■":GOSUB2480
90 Z$=" ":FORI=1TO21:Z$=Z$+" ":NEXT
100 B$="":FORI=1TO22:B$=B$+"▒":NEXT
110 N=0:K=4140:P1=0:A1=0:TR=1
120 DEFFNA(X)=INT(X*RND(1))
130 DEFFNB(X)=INT((8-9*RND(1))/7)
140 PRINT"♥"TAB(7)"* GOLF *■■
150 PRINT"WELCOME TO THE LINKS! THIS";
160 PRINT" IS AN              18-HOLECOURSE OF     PR";
170 PRINT"OFESSIONAL STANDARD (COURS";
180 PRINT"E RECORD IS 2   UNDER ),80 P";
190 PRINT"LEASE       REPLACE DIVOTS & SHOW COURTESY TO
    FELLOW GOLFERS.
200 PRINT"■HAVE A GOOD ROUND-SEE YOU AT THE 19TH!!
210 PRINT"■■■WHAT IS YOUR HANDICAP"
220 INPUTH:IFH>=0ANDH<30THEN240
230 PRINT"■PGA RULES HANDICAP 0-30":GOTO210
240 POKE36879,108:PRINT"♥■DIFFICULTIES AT GOLF■
250 PRINT" 1.HOOKING
260 PRINT" 2.SLICING
270 PRINT" 3.POOR DISTANCE
280 PRINT" 4.TRAP SHOTS
290 PRINT" 5.PUTTING■
300 INPUT"YOUR WORST";F:F=INT(F)
310 H=INT(H):IFF>0ANDF<6THEN330
320 PRINT"DON'T BE SHY":GOTO300
330 POKE36879,238:PRINT"♥■SELECTION OF CLUBS"
340 PRINT"────────────────────"
350 PRINT"■YARDAGE  CLUBS    NO.
360 PRINT"280-200 1-4WOODS  1-4"
370 PRINT"200-100 1-5IRONS 11-15"
380 PRINT"■100-0   6-9IRONS 16-19"
390 PRINT"■TO FADE OR DRAW THE   BALL";
400 PRINT" TYPE F OR D WHEN ASKED"
410 PRINT"TO HIT STRAIGHT TYPE  RETURN"
420 PRINT"■*******WARNING*******■
430 PRINT"DON'T HIT IT TOO HARD■
440 GOSUB2480:GOSUB1410:GOSUB2480
450 REM GENERATE HOLE
460 Z=K:G=102:N=N+1:READD,P:PRINT"♥■■■
470 FORI=1TO18:PRINTB$;:NEXT
480 PRINT"■HOLE";N;:S=4:A=0
490 PRINTD;"YDS.";"PAR";P;
500 T=K+154:E=1:FORI=1TO22:FORJ=1TOS
510 POKET,32:T=T+22*E:NEXTJ:T=T-22*E
520 U=FNB(1):S=S+U
530 IFS<4ORS>8THENS=S-U:GOTO520
540 T=T+1+22*FNB(1):E=-E:NEXTI
550 S=3:T=T+43:FORI=1TO5:FORJ=1TOS
560 O=160:IFI=3ANDJ=2THENO=43:Q=T
570 POKET,O:T=T+22*E:NEXTJ:T=T-22*E
580 U=FNB(1):S=S+U
590 IFS<3THENS=S-U:GOTO580
600 T=T-1+22*FNB(1):E=-E:NEXTI:O=69
610 FORI=1TO4+FNA(8)
620 S=K+O+FNA(9)+22*FNA(15)
630 IFPEEK(S)=32THENPOKES,87
640 NEXT:IFO=69THENO=55:GOTO610
650 POKEK+198,148
660 X=0:Y=19:V=39:W=(Q-K-19)/11:L=1
670 IFD>450ANDD<550THEN1150
680 IFRND(1)>.6THEN1110
690 PRINT"■■■■■■■▔▔▔■■■■■   ■■■■■▁▁▁|
700 GOSUB1510
710 PRINT"■CHOOSE CLUB ";
720 INPUTC$:C=VAL(C$):C=INT(C)
730 IF(C>0ANDC<5)OR(C>9ANDC<20)THEN760
740 PRINT"■NO SUCH CLUB ":GOSUB1530
750 GOTO700
760 QQ=0:IFC<15THENB=100:GOTO1340
770 PRINT"■DISTANCE% (0-100)    ■■■";
780 INPUTB$:B=VAL(B$):IFB>0ANDB<=100THEN800
790 PRINT"I SAID 0-100! WELL";:GOTO780
800 B=B/100:IFF=3THENB=B*.85
810 IFL=2THENB=B*AA:IFC<3THENB=B*.7
820 GOSUB1530:REM DISTANCE
830 M=290-FNA(12)-(H+30)*.7-C*8.3
840 M=INT((B*M*39/D)+.5):Q=0
850 A=A+1:PRINT"■■■■■■■■■";CHR$(A+48)
860 IFRND(1)>.3+H/90THEN910
870 Q=(H+30)*(RND(1)+.1)*π/500
880 IFF>2THENU=.5:GOTO900
890 Q=Q*1.5:U=.9:IFF=2THENU=.1
900 IFRND(1)>UTHENQ=-Q
910 IFV=XTHENT=π/2:X=X-SGN(Y-W):GOTO930
920 T=ATN((Y-W)/(V-X))+Q-QQ
930 U=X+SGN(V-X)*INT(M*COS(T)+.5)*TR
940 Y=Y-SGN(V-X)*INT(M*SIN(T)+.5):X=U
950 TR=1
960 IFX>43ORY<0ORY>35THEN1200
970 S=K+INT(X/2)+22*INT(Y/2):T=PEEK(S)
980 U=126:IF(YAND1)=1THENU=123
990 IF((XAND1)=1AND(YAND1)=1)THENU=108
1000 IF((XAND1)=1AND(YAND1)=0)THENU=124
1010 POKEZ,G:POKES,U:G=T:Z=S
1020 FORI=1TO9:POKES,G:FORJ=1TO99:NEXTJ
1030 POKES,U:FORJ=1TO99:NEXTJ:NEXTI
1040 GOSUB1530:IFX=VANDY=WTHEN1390
1050 IFG=160ORG=43THEN1540
1060 IFG=102THENL=2:GOTO2190
1070 IFG=87THEN2240
1080 IFG=193THENL=4:GOTO2400
1090 IFG=174THEN2440
1100 L=1:GOTO700
1110 U=K+55+FNA(11):T=1:FORI=0TO4
1120 IFPEEK(22*I+U)=32THENU=U+264:T=-1:GOTO1140
1130 NEXT
1140 FORI=1TO12:POKEU+T*22*FNA(5)-FNA(8),193:NEXT:GOTO690
1150 C=K+7:U=1
1160 IFRND(8)<.5THENC=C+7:U=-1
1170 FORI=1TO17
1180 POKEC,174:IFRND(1)>.6THENC=C+U
1190 C=C+22:NEXT:GOTO690:REM WATER
1200 IFX>45THEN1250:REM O.O.B.
1210 IFX>43THENX=43
1220 IFY>=0ANDY<36THEN1300
1230 IFY>35ANDY<48THENY=35:GOTO1300
1240 IFY<0ANDY>-11THENY=0:GOTO1300
1250 GOSUB1510
1260 PRINT"TOO MUCH CLUB-LOST    BALL"
1270 PRINT"PENALTY ■6 STROKES■":A=A+6
1280 GOSUB1530
1290 PRINT"♥":GOTO1910
1300 GOSUB1510
1310 PRINT"OUT OFF BOUNDS-DROP   BALL"
1320 PRINT"PENALTY ■1 STROKE":A=A+1
1330 GOTO970
1340 PRINT"■FADE OR DRAW";
1350 INPUT"■■▔   ■■■■■■";A$
1360 IFA$="F"THENQQ=.15
1370 IFA$="D"THENQQ=-.15
1380 GOTO800
1390 PRINT"♥YOU HOLED OUT !!!!■■
1400 PRINT"LUCKY!!":GOTO1820
1410 POKE36879,59:PRINT"♥■NOTATION USED
1420 PRINT"────────────────■
1430 PRINT"▒=ROUGH■
1440 PRINT"O=TRAPS (KEEP OUT!)■
1450 PRINT" =FAIRWAY■
1460 PRINT"■ ■=GREEN■
1470 PRINT"+=THE HOLE■
1480 PRINT"■T■=THE TEE (OF COURSE!)■
1490 PRINT"■.■=WATER (LOST BALL!)■
1500 PRINT"■■=TREES■":RETURN
1510 PRINT"■";Z$;:PRINTZ$;:PRINTZ$;
1520 PRINT"■";:RETURN
1530 FORI=1TO2000:NEXT:RETURN
1540 PRINT"♥ON THE GREEN IN ";A
1550 IFRND(1)>.6THENJA=1:GOTO1590
1560 IFRND(2)>.5THENJA=1.27:GOTO1580
1570 PRINT"■■■■"TAB(5)"■SLOW GREEN":JA=.73:GOTO1590
1580 PRINT"■■■■"TAB(5)"■FAST GREEN"
1590 KK=K+286:M=1:T=1:IFF=5THENM=3
1600 GOSUB1530:GOSUB1510
1610 FORI=22TO43:POKEKK+I,99:NEXT
1620 POKEKK+15,93:POKEKK-7,93:POKEKK-29,225
1630 POKEKK-28,160
1640 D=INT(D*SQR((X-V)↑2+(Y-W)↑2)/31)
1650 IFD>58THEND=56+FNA(3)
1660 POKEKK+15-INT(D/4),81
1670 PRINT"■YOU ARE";D;"FEET FROM   THE PIN"
1680 PRINT"■CHOOSE PUTTING          STRENGTH (0-13)       ■■■■■■■"
1690 INPUTC$
1700 C=VAL(C$)
1710 IFC>0ANDC<=13THENA=A+1:GOTO1730
1720 PRINT"♥";Z$;"♥♥";:GOTO1680
1730 E=C*(4+M*RND(1))-2.5+(RND(1)*(H+30)/40)*M:E=INT(E*JA):M=M*.8
1740 FORI=1TOE:D=D-1:S=INT(KK+15-D*T/4)
1750 FORJ=1TOI:NEXTJ
1760 POKES,81:POKES-T,32
1770 IFS<>KK+15THENPOKEKK+15,93
1780 NEXTI:REM **MIGHT RUN OF GREEN
1790 IFD<0THENT=-T:D=-D
1800 IFS=KK+15THENFORI=1TO99:NEXT:POKES,93:GOTO1820
1810 GOSUB1530:GOSUB1510:GOTO1670
1820 GOSUB1530:REM PUTTING
1830 PRINT"♥YOU'RE DOWN IN";A;
1840 ON(A-P+3)GOTO1880,1870,1860,1910,1910
1850 PRINT"     -KEEP YOUR HEAD DOWN":GOTO1920
1860 PRINT"      A PAR-NICE GOING":GOTO1920
1870 PRINT"     -A BIRDIE WELL PLAYED!":GOTO1920
1880 IFP=3THEN1900
1890 PRINT"     -A GREAT BIG EAGLE!!!":GOTO1920
1900 PRINT" A HOLE IN ONE !!!!!
1910 PRINT
1920 P1=P1+P:A1=A1+A:IFP1=A1THEN1970
1930 A$="UNDER":IFA1>P1THENA$="OVER"
1940 PRINT"■■ YOU ARE";ABS(P1-A1);
1950 PRINTA$;" PAR   AFTER";N;"HOLES
1960 GOTO1980
```

HAMPIONSHIPS

```
1970 PRINT" LEVEL PAR AFTER";N;"    HOLES
1980 PRINT"";:GOSUB2480
1990 B$=""
2000 IFN<18THEN450
2010 PRINT" *** GAME OVER ***
2020 ONINT((A1-P1)/5+2)GOTO2150,2120,2080
2030 PRINT"YOU'VE HACKED YOUR WAY";
2040 PRINT" ROUND BADLY. BEST TAKE";
2050 PRINT" SOME LESSONS BEFORE YOU";
2060 PRINT" DIG UP THIS COURSE AGAIN
2070 GOTO2180
2080 PRINT"AN AVERAGE ROUND-YOU";
2090 PRINT" SHOULD IMPROVE NEXT TIME
2100 PRINT"SEE THE CLUB PRO(RPT) FOR A";
2110 PRINT" FEW TIPS":GOTO2180
2120 PRINT"CONGRATULATIONS! YOU P";
2130 PRINT"LAYED A GOOD ROUND I LI";
2140 PRINT"KE YOUR STYLE";:GOTO2180
2150 PRINT"AN UNDER PAR ROUND!!
2160 PRINT"NEXT TIME YOU PLAY TRY "
2170 PRINT"A HIGHER HANDICAP
2180 END
2190 REM ROUGH
2200 GOSUB1510:IFABS(Y-17)>10THEN2220
2210 AA=.75:PRINT"IN LIGHT ROUGH":GOTO2230
2220 AA=.5:PRINT"YOU ARE IN HEAVY ROUGH
2230 GOSUB1530:GOTO700
2240 GOSUB1510:REM TRAP
2250 PRINT"** BUNKERED **":GOSUB1530
2260 GOSUB1510
2270 INPUT"WHICH CLUB";C$:C=VAL(C$)
2280 IFC>11ANDC<20THEN2320
2290 PRINT"YOU WON'T GET OUT WITH "
2300 PRINT"THAT":GOSUB1530
2310 GOSUB1510:GOTO2270
2320 INPUT"% AGE SWING  ";B$:B=VAL(B$)
2330 M=68+FNA(17)-(19-C)*5-(100-B)*.4
2340 IFF=4THENM=M*.7
2350 IFRND(1)<.4THENM=M/3
2360 IFM>25THENOO=0:B=1:GOTO840
2370 GOSUB1510
2380 PRINT"YOU FLUFFED IT":GOSUB1530
2390 A=A+1:GOTO2240
2400 REM TREES
2410 GOSUB1510:PRINT" IN THE TREES
2420 PRINT"YOU CAN ONLY HACK OUT SIDEWAYS
2430 TR=0:GOSUB1530:GOTO700
2440 REM WATER
2450 GOSUB1510:PRINT" **SPLASH !!! **
2460 PRINT"IN THE STREAM-LOST BALL
2470 GOSUB1530:GOSUB1510:GOTO1270
2480 PRINT"HIT A KEY TO CONTINUE"
2490 GETA$:IFA$=""THEN2490
2500 RETURN
2510 DATA367,4,445,4,314,4,189,3,520,5
2520 DATA331,4,468,4,375,4,177,3,424,4
2530 DATA562,5,336,4,208,3,447,4,298,4
2540 DATA543,5,385,4,478,4
```

UNEXPANDED

THIS IS A program for the unexpanded Vic-20. The first part, Golf Chars, contains the title, instructions and data for special characters. This must be entered and run first and should be Saved on cassette before typing New and entering the second part, Golf Game. The program uses nearly all the available memory, so do not add any spaces when typing in. Some of the lines are very long and must be entered using the standard abbreviations.

The game consists of a series of nine holes, which will be different every time. The object is, of course, to get the ball into each hole in as few strokes as possible. The fairway is shown in plain green, the bunker in yellow and the water hazard in blue. The hole is marked by a flag in the centre of the green. The ball can be hit in any direction, including diagonally, but only when the man is next to it. The direction of the hit is determined by the relative positions of man and ball, the latter moving directly away from the man.

When the man is in the position you want, press T and then enter the required club size, which will be a number from 1 to 9. Numbr 1 will hit the ball furthest. If the ball is in the rough it will not move as far as it would on the fairway and if you try to use your putter — number 9 — from the rough it will not move at

(continued on page 93)

Listing 1. Unexpanded golf game.

```
1 PRINT"**** THE VIC OPEN ****":PRINT"9-HOLE GOLF GAME"
3 PRINT"***********"
5 PRINT"COPYRIGHT V. ALLSOPP        1983"
10 V=36878:POKEV,15
11 READN,D:IFN=-1THENPOKEV,0:POKEV-2,0:POKEV-3,0:GOTO20
12 POKEV-3,N:POKEV-2,N:FORT=1TOD:NEXT:GOTO11
15 DATA195,200,207,200,215,600,0,200,195,200,215,200,209,600,0,200
16 DATA215,400,207,400,195,400,175,400,-1,-1
20 POKE51,0:POKE52,28:POKE55,0:POKE56,28:CB=7168
25 READA:IFA=-1THEN40
30 FORN=0TO7:READB:POKECB+N+8*A,B:NEXT
35 GOTO25
40 PRINT"    DO YOU REQUIRE     INSTRUCTIONS? (Y/N)"
50 GETA$:IFA$=""THEN50
55 IFA$="Y"THEN70
60 IFA$="N"THENPRINT"O.K. PLEASE TYPE 'NEW'AND LOAD AND RUN      'GOLF GAME
'."
65 PRINT"GOOD LUCK!":END
70 PRINT"MOVE THE MAN TO THE    BALL USING KEYS:-"
75 PRINT"A - UP    Z - DOWN    N - LEFT  M - RIGHT"
80 PRINT"(THE BALL WILL MOVE   DIRECTLY AWAY FROM THEMAN WHEN HIT.)"
85 PRINT"PRESS SPACE TO CONT."
90 GETA$:IFA$<>" "THEN90
95 PRINT"WHEN MAN IS IN CORRECTPOSITION, PRESS 'T'.   YOU WILL BE ASKED TO"
100 PRINT"ENTER CLUB SIZE (A NO.FROM 1 TO 9). 1 IS THEHEAVIEST CLUB AND 9 IS
"
105 PRINT"A PUTTER WHICH ONLY   MOVES THE BALL ONE    SQUARE."
110 PRINT"PRESS SPACE TO CONT."
115 GETA$:IFA$<>" "THEN115
120 PRINT"TRY TO KEEP THE BALL  ON THE FAIRWAY AND    AVOID THE HAZARDS."
122 PRINT"PAR FOR THE COURSE IS 36 STROKES."
125 PRINT"NOW TYPE 'NEW' AND    LOAD AND RUN          'GOLF GAME'":PRINT"
QGOOD LUCK":END
1010 DATA0,0,0,0,24,24,0,0,0
1020 DATA28,16,24,28,30,16,16,16,16
1030 DATA35,24,24,60,90,90,60,36,102
1040 DATA36,24,60,126,255,255,126,60,24
1050 DATA37,24,24,24,24,24,24,24,24
1060 DATA26,255,255,255,255,255,255,255,255
1070 DATA1,3,15,63,63,127,127,255,255
1080 DATA2,192,240,252,252,254,254,255,255
1090 DATA3,255,255,254,254,252,252,240,192
1100 DATA4,255,255,127,127,63,63,15,3
1110 DATA32,17,34,68,136,17,34,68,136
1120 DATA5,252,126,126,63,63,126,126,252,-1
```

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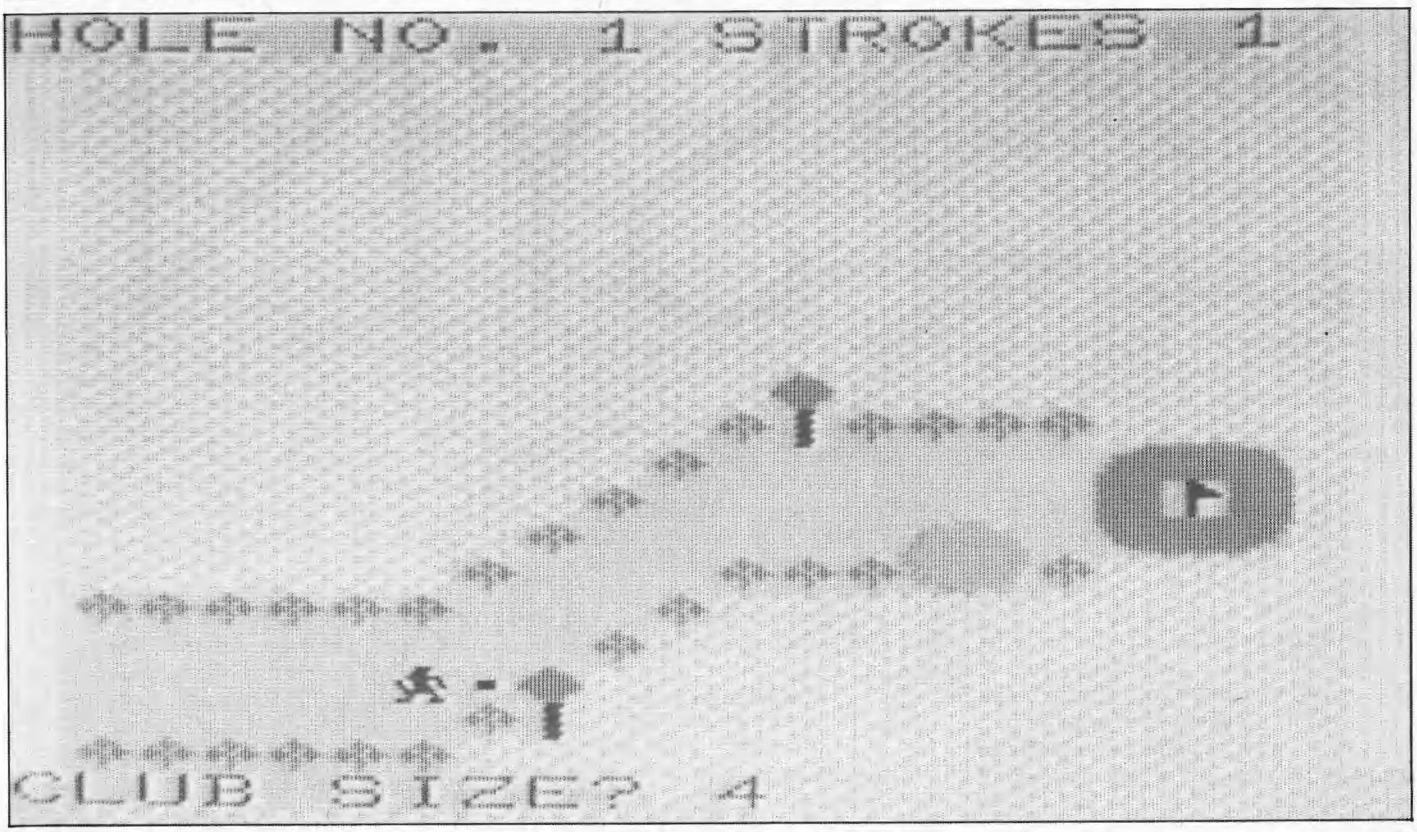


Listing 2. Expanded golf game.

```
  0 REM FOR "#" READ INVERSE POUND SIGN
  1 REM GOLF GAME
  2 REM COPYRIGHT
  3 REM V. ALLSOPP 1983
 10 POKE36879,217 PRINT"□":H=0:SR=0:C=30720
 40 POKE36869,255:A=RND(0)
 50 PRINT"□":SC=0
 60 A=INT(RND(1)*5)+1 B=INT(RND(1)*9): D=14-A-B:H=H+1 POKE198,0:IFH>9THENGOSUB500
0 GOTO600
 61 IFB<5THENZ=7730:V=23:V=0:GOTO70
 65 Z=8010 V=21:V=2
 70 FORX=0TOV W=Z+X POKEW+1,216 POKEC+1+W,5
 75 POKEW+23,160 POKEW+45,160 POKEW+67,160
 80 POKEW+89,216 POKEC+89+W,5 NEXT
 89 IFB=0THEN110
 90 FORX=1TOV*8STEPV W=Z+V+A+X POKEW,216 POKEC+W,5
 95 POKEW+22,160 POKEW+44,160 POKEW+66,160
 100 POKEZ+88+A+X,216 POKEC+88+Z+A+X,5 NEXT
 110 FORW=0TOD W=Z/V/V*D/V POKEW+2,216 POKEC+2+W,5
 115 POKEW+24,160 POKEW+46,160 POKEW+68,160 NEXT
 120 FORX=0TOD+1 W=Z+A+V*B+X POKEW+89,216 POKEC+89+W,5 NEXT
 130 F=Z+62+(V-1)*B:POKEF,28:POKEC+F,0
 140 POKEF-1,26:POKEF+1,26:POKEF-22,26:POKEF+22,26
 145 POKEC+F-1,5:POKEC+F+1,5:POKEC+F-22,5:POKEC+F+22,5
 150 W=Z+22*Y+A:POKEW+25,37:POKEC+25+W,2:POKEW+3,36:POKEC+3+W,5
 160 W=Z+A+V*B:POKEW+2,37:POKEC+2+W,2:POKEW-20,36:POKEC-20+W,5
 170 POKEF-23,1:POKEF-21,2:POKEF+21,4:POKEF+23,3
 175 POKEC+F-23,5:POKEC+F-21,5:POKEC+F+21,5:POKEC+F+23,5
 176 IFA>2THEN180
 177 POKEF-2,5:POKEF+C-2,6:POKEF-24,5:POKEF+C-24,6:POKEF+20,5:POKEF+C+20,6
 180 W=Z+(V-1)*B:POKEW+80,1:POKEC+80+W,7:POKEW+81,2:POKEC+81+W,7
 190 POKEW+102,4:POKEC+102+W,7:POKEW+103,3:POKEC+103+W,7
 193 FORX=7680TO8098STEP22:POKEX,230:NEXT:FORX=7701TO8119STEP22:POKEX,230:NEXT
 200 PRINT"■■HOLE NO."H
 210 B=Z+45:BC=B+C:POKEB,0:M=7724:MC=M+C:POKEM,35:POKEMC,2:POKEBC,0
 220 N=230:NC=1:Q=160:QC=1:V=36878
 400 P1=PEEK(197):IFP1=17THENDM=-22:GOSUB1000
 405 IFP1=33THENDM=22:GOSUB1000
 410 IFP1=28THENDM=-1:GOSUB1000
 415 IFP1=36THENDM=1:GOSUB1000
 420 IFP1=50THENGOSUB2000
 430 POKE198,0:IFP=28THENP=0:GOTO50
 440 GOTO400
 600 FORX=1TO6000:NEXT:POKE36869,240:PRINT"□":END
 1000 IF(M+DM)<77020R(M+DM)>8185THENDM=0:RETURN
 1010 P2=PEEK(M+DM):IFP2=0ORP2=36ORP2=37ORP2=28ORP2=5THENDM=0:RETURN
 1020 POKEM,N:POKEMC,NC:N=PEEK(M+DM):NC=PEEK(MC+DM):POKEV,15:POKEV-2,200:POKEV-2
0:POKEV,0
 1030 M=M+DM:POKEM,35:MC=M+C:POKEMC,2:RETURN
 2000 DB=B-M:IFDB=1ORDB=-1OR(DB>-24ANDDB<-20)OR(DB>20ANDDB<24)THEN2004
 2001 RETURN
 2004 POKE198,0:INPUT"■■■■■■■■■■■■■■■■■■■■■■■■CLUB SIZE";CL:PRINT"■":IFCL<1ORCL>9
THEN2004
 2005 IFQC=247ORQC=231ORQC=167ORQC=7ORQC=39ORQC=23ORCL=9THENR=1:GOTO2009
 2008 R=10-CL+INT(RND(1)*(12-CL)/2)
 2009 IFQ=32THENR=R-1
 2012 SC=SC+1:PRINT"■■■■■■■■■■■■■■STROKES";SC
 2014 W=B+R*DB
 2015 P=PEEK(W):IFP=36ORP=37THENW=W-DB:GOTO2015
 2020 IFW<7724ORW>8163THENW=B:RETURN
 2023 FORX=BTOWSTEPDB:P=PEEK(X):IFP=23OTHENW=X-DB:GOTO2025
 2024 NEXT:P=PEEK(W)
 2025 IFW=MTHEN:W=W-1
 2026 POKEV,15:FORX=1TO2:POKEV-1,240:NEXT:POKEV-1,0:FORX=0TO200:NEXT
 2027 FORX=220TO220-10*RSTEP-2:POKEV-2,X:NEXT:POKEV,0:POKEV-2,0:IFP=5THENGOSUB45
00
 2028 IFW=MTHEN:W=W-1
 2029 IFP=28THENGOSUB4000:RETURN
 2030 POKEB,Q:B=W:Q=PEEK(B):POKEB,0:POKEBC,QC:BC=B+C:QC=PEEK(BC):POKEBC,0:RETURN
 4000 POKEV,15:POKEV-1,240:FORX=1TO2:NEXT:POKEV,0
 4005 PRINT"■■■HOLE NO."H"COMPLETED  ■IN"SC;"STROKES":SR=SR+SC
 4010 PRINT"■■■■■TOTAL "SR"STROKES":FORX=1TO5000:NEXT:RETURN
 4500 PRINT"■■■■■■■■■■■■■■■■■■■■■■IN THE WATER - LOSE A STROKE■":SC=SC+1:W=W-1
 4502 IFW=F+19THENW=W-22
 4505 POKEB,Q:B=W:Q=PEEK(B):POKEBC,QC:BC=B+C:QC=PEEK(BC)
 4510 FORX=1TO3000:NEXT:PRINT"■■■■■■■■■■■■■■■■■■■■■■S"
 4515 PRINT"■■■■■■■■■■■■■STROKES";SC:RETURN
 5000 PRINT"■■■■■YOU HAVE COMPLETED 9  ■■HOLES WITH A TOTAL OF ■■"SR" STROKES"
 5010 IFSR>36THENPRINT"■■■THIS IS "SR-36"STROKES":PRINT"■■■OVER PAR"
 5020 IFSR=36THENPRINT"■■■THIS IS PAR FOR THE   ■■COURSE"
 5030 IFSR<36THENPRINT"■■■THIS IS "36-SR"STROKES":PRINT"■■■UNDER PAR"
 5040 RETURN
```

(continued from page 91)

all. It can also hit trees, get stuck in the bunker or lost in the water but it cannot be hit off the screen, nor will it scroll around the sides. The man cannot stand on the trees or the flag or in the water.

Program structure.

Golf characters

Lines	1 to 5	Title
	10 to 16	Play tune
	20	Lowers top of Basic to protect character data
	25 to 35	Reads data for characters
	40 to 125	Instructions
	1010 to 1120	Data for characters

Golf game

Lines	1 to 3	Copyright
	10 to 220	Initialise variables and set up screen
	400 to 420	Keyboard scan
	1000 to 1030	Subroutine to move man
	2000 to 2030	Subroutine to move ball
	4000 to 4010	Subroutine to print score
	4500 to 4515	Subroutine for ball in water
	5000 to 5040	Subroutine giving scores for nine holes

CBM 64 SYNT

Duran Duran do it. Depeche Mode do it. Yazoo do it. Now you can do it too. Make beautiful music with Stephen Watson's simple synthesiser program.

WEIRD AND WONDERFUL sounds — anything from a banjo to an ondes martenot — can be made to emanate from the CBM 64 by using this simple program. It has been written in straightforward Basic to enable beginners to grasp the methods used, making it easy for them to butcher the program to their own requirements. It also contains graphic sections to aid the user in defining his own instruments.

Synth-sound 64 allows the user to play the computer like a synthesiser. It has the facility to define 12 separate instruments, four of which are already defined within the program — piano, banjo, xylophone and woodwind. It is possible to change waveforms while playing by pressing the f keys on the right-hand side of the keyboard; octaves can be selected by pressing the numerical keys 1 to 4 on the top left-hand side of the keyboard. Key 1 is the highest octave.

The program should be run and listed in the lower case mode. You will be presented with a menu showing the 12 different instrument options and asking if you wish to redefine. You can select the piano option, for example, by keying in the £ sign: when the £ sign appears on the screen, depress the plus sign — the £ sign disappears. Your keyboard is now "live", meaning that it will play the sound designated as piano when you hit the right keys. These are shown on-screen, and a mock keyboard on the screen display shows you where this would fall on a real keyboard.

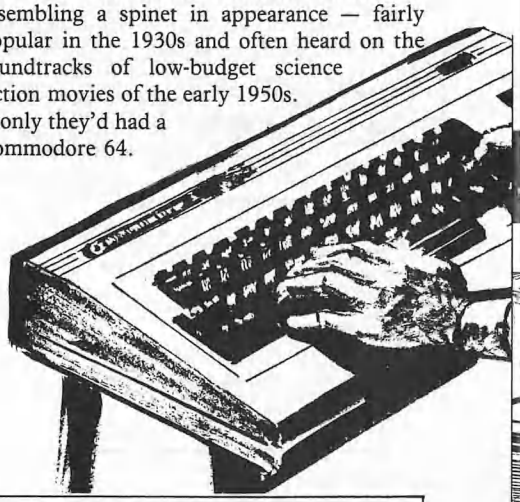
If you want to break new ground in avant-garde music by defining the sound of a goat in a room, the death throes of a neutron start, or a mighty ship ascending, press the left arrow followed by a nine and you will be asked what instrument you wish to examine out of the eight programmable ones. Once you have made your selection, the options presented are:

Attack/decay 0-255
Sustain/release 0-255
Wave-form S,T,M or P

Having defined the fundamental sound you will be returned to the menu. Key in the left arrow plus the number of the sound you just defined and your keyboard will be "live" again. Together with the four waveform keys and the four octave keys previously mentioned, you can achieve anything from a Vivaldi-type harpsichord to a drum sound worthy of Echo and the Bunneymen. Special effects, such as steam trains and gunshots are also possible.

If, while defining an instrument, you wish to leave a setting the same, just press Return only and the computer will skip over leaving the contents of that particular value unaltered and move to the next setting. While playing you can silence the voices by pressing CLR Home — unshifted — but remember that you cannot use the pulse waveform — f7 — on an instrument that has Hi and Lo pulse rates set at zero. Flags are displayed on the screen to show the user which instruments he can call on.

And, for those of you who may still be wondering, an ondes martenot is an old-fashioned electronic musical instrument resembling a spinet in appearance — fairly popular in the 1930s and often heard on the soundtracks of low-budget science fiction movies of the early 1950s. If only they'd had a Commodore 64.



```
1 REM SYNTH SOUND - FOR "£" READ INVERSE POUND SIGN
2 REM ** WRITTEN BY S.A.WATSON **
3 AD=12:SR=12:W=33:HP=0:LP=0:POKE54296,15
4 GOSUB 1000:GOSUB 3000
6 REM ******************
7 REM * VOICE ROUTINE *
8 REM ******************
9 REM
10 GET K$:IF K$="" THEN 10
11 GOSUB 100
12 IF K$="" THEN10
13 POKE 54276,0
14 POKE54277,AD
15 POKE54278,SR
16 POKE54275,HP:POKE54274,LP
17 POKE54276,W
18 POKE54273,A:POKE54272,B
20 GET K$:IF K$="" THEN 20
21 GOSUB 100
22 IF K$="" THEN20
23 POKE54283,0
24 POKE54284,AD
25 POKE54285,SR
26 POKE54282,HP:POKE54281,LP
27 POKE54283,W
28 POKE54280,A:POKE54279,B
30 GET K$:IF K$="" THEN 30
31 GOSUB 100
32 IF K$="" THEN 30
33 POKE54290,0
34 POKE54291,AD
35 POKE54292,SR
36 POKE54289,HP:POKE54288,LP
37 POKE54290,W
38 POKE54287,A:POKE54286,B
39 GOTO 10
40 REM
41 REM ******************
42 REM * OCTAVE 1 TABLE *
43 REM ******************
44 REM
100 IF O=2 THEN 200
101 IF O=3 THEN 300
102 IF O=4 THEN 400
103 IF K$="£" THEN POKE54276,0:POKE54283,0:POKE54290,0:
    K$="":RETURN
105 IF K$="2" THEN O=2:K$="":RETURN
106 IF K$="3" THEN O=3:K$="":RETURN
107 IF K$="4" THEN O=4:K$="":RETURN
112 IF K$="Z" THEN A=28:B=214:RETURN
113 IF K$="X" THEN A=32:B=94 :RETURN
114 IF K$="C" THEN A=34:B=75 :RETURN
115 IF K$="V" THEN A=38:B=126:RETURN
125 IF K$="B" THEN A=43:B=52 :RETURN
130 IF K$="N" THEN A=45:B=198:RETURN
135 IF K$="M" THEN A=51:B=97 :RETURN
140 IF K$="," THEN A=57:B=172:RETURN
145 IF K$="." THEN A=64:B=188:RETURN
150 IF K$="/" THEN A=68:B=149:RETURN
151 REM
152 REM        ** SHARPS **
153 REM
154 IF K$="S" THEN A=30:B=141:RETURN
155 IF K$="F" THEN A=36:B=85 :RETURN
160 IF K$="G" THEN A=40:B=200:RETURN
161 IF K$="J" THEN A=48:B=127:RETURN
165 IF K$="K" THEN A=54:B=111:RETURN
170 IF K$="L" THEN A=61:B=126:RETURN
175 IF K$=";" THEN A=72:B=169:RETURN
189 IF K$="←" THEN GOSUB 650
190 IF K$="\" THEN GOSUB 600
191 IF K$="■" THEN W=33:K$="":RETURN
192 IF K$="■" THEN W=17:K$="":RETURN
193 IF K$="■" THEN W=129:K$="":RETURN
194 IF K$="■" THEN W=65:K$="":RETURN
195 K$="":RETURN
196 REM
197 REM ******************
198 REM * OCTAVE 2 TABLE *
199 REM ******************
200 IF K$="£" THEN POKE54276,0:POKE54283,0:POKE54290,0:
    K$="":RETURN
201 IF K$="1" THEN O=1:K$="":RETURN
202 IF K$="3" THEN O=3:K$="":RETURN
203 IF K$="4" THEN O=4:K$="":RETURN
212 IF K$="Z" THEN A=14:B=107:RETURN
213 IF K$="X" THEN A=16:B=47 :RETURN
214 IF K$="C" THEN A=17:B=37 :RETURN
215 IF K$="V" THEN A=19:B=63 :RETURN
225 IF K$="B" THEN A=21:B=154:RETURN
230 IF K$="N" THEN A=22:B=227:RETURN
235 IF K$="M" THEN A=25:B=177:RETURN
240 IF K$="," THEN A=28:B=214:RETURN
245 IF K$="." THEN A=32:B=94 :RETURN
250 IF K$="/" THEN A=34:B=75 :RETURN
251 REM
252 REM        ** SHARPS **
253 REM
254 IF K$="S" THEN A=15:B=70 :RETURN
255 IF K$="F" THEN A=18:B=42 :RETURN
260 IF K$="G" THEN A=20:B=100:RETURN
261 IF K$="J" THEN A=24:B=63 :RETURN
265 IF K$="K" THEN A=27:B=56 :RETURN
270 IF K$="L" THEN A=30:B=141:RETURN
275 IF K$=";" THEN A=36:B=85 :RETURN
289 IF K$="←" THEN GOSUB 650
290 IF K$="\" THEN GOSUB 600
291 IF K$="■" THEN W=33:K$="":RETURN
292 IF K$="■" THEN W=17:K$="":RETURN
293 IF K$="■" THEN W=129:K$="":RETURN
294 IF K$="■" THEN W=65:K$="":RETURN
295 K$="":RETURN
296 REM
297 REM ******************
298 REM * OCTAVE 3 TABLE *
299 REM ******************
300 IF K$="£" THEN POKE54276,0:POKE54283,0:POKE54290,0:
    K$="":RETURN
301 IF K$="1" THEN O=1:K$="":RETURN
302 IF K$="2" THEN O=2:K$="":RETURN
303 IF K$="4" THEN O=4:K$="":RETURN
312 IF K$="Z" THEN A= 7:B=53 :RETURN
313 IF K$="X" THEN A= 8:B=23 :RETURN
314 IF K$="C" THEN A= 8:B=147:RETURN
315 IF K$="V" THEN A= 9:B=159:RETURN
325 IF K$="B" THEN A=10:B=205:RETURN
330 IF K$="N" THEN A=11:B=114:RETURN
335 IF K$="M" THEN A=12:B=216:RETURN
340 IF K$="," THEN A=14:B=107:RETURN
345 IF K$="." THEN A=16:B=47 :RETURN
350 IF K$="/" THEN A=17:B=37 :RETURN
351 REM
352 REM        ** SHARPS **
353 REM
354 IF K$="S" THEN A= 7:B=163:RETURN
360 IF K$="F" THEN A= 9:B=21 :RETURN
361 IF K$="G" THEN A=10:B=60 :RETURN
365 IF K$="J" THEN A=12:B=32 :RETURN
370 IF K$="K" THEN A=13:B=156:RETURN
375 IF K$="L" THEN A=15:B=70 :RETURN
376 IF K$=";" THEN A=18:B=42 :RETURN
389 IF K$="←" THEN GOSUB 650
390 IF K$="\" THEN GOSUB 600
391 IF K$="■" THEN W=33:K$="":RETURN
392 IF K$="■" THEN W=17:K$="":RETURN
393 IF K$="■" THEN W=129:K$="":RETURN
394 IF K$="■" THEN W=65:K$="":RETURN
395 K$="":RETURN
396 REM
397 REM ******************
398 REM * OCTAVE 4 TABLE *
399 REM ******************
400 IF K$="£" THEN POKE54276,0:POKE54283,0:POKE54290,0
    :K$="":RETURN
401 IF K$="1" THEN O=1:K$="":RETURN
402 IF K$="2" THEN O=2:K$="":RETURN
403 IF K$="3" THEN O=3:K$="":RETURN
412 IF K$="Z" THEN A= 3:B=155:RETURN
413 IF K$="X" THEN A= 4:B=12 :RETURN
414 IF K$="C" THEN A= 4:B=73 :RETURN
415 IF K$="V" THEN A= 4:B=208:RETURN
425 IF K$="B" THEN A= 5:B=103:RETURN
430 IF K$="N" THEN A= 5:B=185:RETURN
435 IF K$="M" THEN A= 6:B=108:RETURN
440 IF K$="," THEN A= 7:B=53 :RETURN
445 IF K$="." THEN A= 8:B=23 :RETURN
450 IF K$="/" THEN A= 8:B=147:RETURN
451 REM
452 REM        ** SHARPS **
454 REM
455 IF K$="S" THEN A= 3:B=210:RETURN
456 IF K$="F" THEN A= 4:B=139:RETURN
460 IF K$="G" THEN A= 5:B=25 :RETURN
461 IF K$="J" THEN A= 6:B=16 :RETURN
465 IF K$="K" THEN A= 6:B=206:RETURN
470 IF K$="L" THEN A= 7:B=163:RETURN
475 IF K$=";" THEN A= 9:B=21 :RETURN
489 IF K$="←" THEN GOSUB 650
490 IF K$="\" THEN GOSUB 600
491 IF K$="■" THEN W=33:K$="":RETURN
492 IF K$="■" THEN W=17:K$="":RETURN
493 IF K$="■" THEN W=129:K$="":RETURN
494 IF K$="■" THEN W=65:K$="":RETURN
495 K$="":RETURN
496 RETURN
594 REM
```

H

```
595 REM ******************************
596 REM * INSTRUMENT CHANGE ROUTINE *
597 REM ******************************
600 REM
602 PRINT"▒▒▒▒▒";TAB(34);"[\]"
605 GET Q$:IF Q$="" THEN 605
608 PRINT"▒▒▒▒▒";TAB(34);"   "
610 IF Q$="+" THEN AD=12:SR=12:W=33:HP=0:LP=0:K$="":RETURN
620 IF Q$="-" THEN AD= 9:SR= 0:W=65:HP= 2:LP=255:K$="":RETURN
630 IF Q$="@" THEN AD=24:SR=15:W=17:HP=0:LP=0:K$="":RETURN
640 IF Q$="*" THEN AD=135:SR=15:W=17:HP=0:LP=0:K$="":RETURN
641 RETURN
642 REM
643 REM ********************************
644 REM * DEFINABLE INSTRUMENT CHANGE *
645 REM ********************************
    650 PRINT"▒▒▒▒▒▒▒▒[←]"
    651 GET X$:IF X$="" THEN 650
    652 PRINT"▒▒▒▒▒▒▒▒   "
    655 IF X$="9" THEN GOSUB 800
    660 IF X$>"8" OR X$<"1" THEN RETURN
    662 X=VAL(X$)
    670 AD=AD(X):SR=SR(X):HP=HP(X):LP=LP(X):W=W(X)
    671 K$="":RETURN
    800 PRINT"▒HAT ▒NSTRUMENT DO YOU WISH TO EXAMINE"
    810 INPUT"▒              1 TO 8 ";DE
    820 IF  DE>8 OR DE<1 THEN 810
    830 PRINT"▒HE ▒NSTRUMENT YOU WISH TO EXAMINE IS:-"
    840 PRINT"▒                 ";IN$(DE)
    850 PRINT"▒TS SETTINGS ARE AS FOLLOWS:-"
    860 PRINT"▒▒▒          ┌───────────────┬──────┐"
    870 PRINT"          |▒▒TTACK/▒ECAY     ▒|▒";AD(DE);TAB(31);"▒|"
    871 PRINT"          ├───────────────┼──────┤"
    872 PRINT"          |▒▒USTAIN/▒ELEASE ▒|▒";SR(DE);TAB(31);"▒|"
    873 PRINT"          ├───────────────┼──────┤"
    874 PRINT"          |▒▒AVEFORM        ▒|▒";W(DE)TAB(31);"▒|"
    875 PRINT"          ├───────────────┼──────┤"
    876 PRINT"          |▒▒IGH ▒ULSE RATE ▒|▒";HP(DE);TAB(31);"▒|"
    877 PRINT"          ├───────────────┼──────┤"
    878 PRINT"          |▒LOW  ▒ULSE RATE ▒|▒";LP(DE);TAB(31);"▒|"
    879 PRINT"          └───────────────┴──────┘"
    880 INPUT "▒    ▒O YOU WISH TO REDIFINE( ▒/▒)▒";T$
    885 IF T$="Y" THEN PRINT"▒▒▒▒▒▒▒▒▒▒":GOSUB 2010
    886 IF T$="N" THEN 895
    895 GOSUB 3000
    900 RETURN
    990 REM
991 REM ************************
992 REM * PROGRAM INTRODUCTION *
993 REM ************************
998 REM
1000 POKE53280,0:POKE53281,0
1010 PRINT"▒           ▒ELLO AND WELCOME TO"
1020 PRINT"▒▒              ▒ ▒▒ ▒▒▒▒▒ 64 ▒"
1030 PRINT"▒▒ITH THIS PROGRAM, YOU CAN PLAY ANY ONE"
1040 PRINT"▒OF FOUR OCTAVES.  ▒OU CAN CHANGE OCTAVES"
1050 PRINT"▒AT  ANY  TIME  WHILE  YOU'RE PLAYING BY"
1060 PRINT"▒PRESSING  KEYS ▒ 1, 2, 3 OR 4. ▒▒HERE ARE"
1070 PRINT"▒ALSO  TWELVE SETS OF SOUNDS THAT CAN BE"
1080 PRINT"▒USED. ▒IGHT OF THESE ARE USER DEFINABLE"
1090 PRINT"▒AND CAN  BE SET  UP AT THE START OF THE"
1100 PRINT"▒PROGRAM, OR REDEFINED WHILE THE PROGRAM"
1110 PRINT"▒IS RUNNING  BY  PRESSING  KEY '←' & '9'"
1120 INPUT"▒▒      ▒NTER '▒▒▒▒▒▒' 1 TO 4 ";O
1125 PRINT"▒"
1130 IF O>4 OR O<1 THEN1120
1140 RETURN
2000 REM
2001 REM ***************************
2002 REM * DEFINABLE INST' SET UP *     2003 REM ***************************
2004 REM
2010 PRINT"▒▒▒▒▒▒▒▒▒▒▒       ▒NTER NAME FOR INSTRUMENT NUMBER ";DE
2020 INPUT"▒               ";IN$(DE)
2030 INPUT "▒▒NTER ▒TTACK/▒ECAY LEVEL(0-255)";AD(DE)
2035 IFAD(DE)>255ORAD(DE)<0THENPRINT"▒ORRY ";AD(DE);" IS OUT OF RANGE":GOTO2030
2040 INPUT "▒▒NTER ▒USTAIN/▒ELEASE LEVEL(0-255)";SR(DE)
2045 IFSR(DE)>255ORSR(DE)<0THENPRINT"▒ORRY ";SR(DE);" IS OUT OF RANGE":GOTO2040
2050 INPUT "▒▒NTER WAVEFORM ▒EQUIRED (▒-▒-▒ OR ▒)";W$(DE)
2060 IF W$(DE)="T" THEN W(DE)=17:GOTO 2990
2065 IF W$(DE)="S" THEN W(DE)=33:GOTO 2990
2070 IF W$(DE)="N" THEN W(DE)=129:GOTO 2990
2075 IF W$(DE)="P" THEN W(DE)=65:GOTO 2100
2080 PRINT"▒▒ORRY ";W$(DE);" NOT UNDERSTOOD":GOTO 2050
2100 INPUT"▒▒NTER THE ▒▒ PULSE RATE(0-15)";HP(DE)
2110 IF HP(DE)<0 THEN PRINT "▒▒ORRY, PULSE RATE TOO ▒▒o":GOTO 2100
2120 IF HP(DE)>15 THEN PRINT"▒▒ORRY, PULSE RATE TOO ▒▒▒":GOTO 2100
2130 INPUT"▒▒NTER THE ▒▒ PULSE RATE(0-255)";LP(DE)
2140 IF LP(DE)<0 THEN PRINT "▒▒ORRY,PULSE RATE TOO ▒▒o":GOTO 2130
2150 IF LP(DE)>255THEN PRINT"▒▒ORRY,PULSE RATE TOO ▒▒▒":GOTO 2130
2990 RETURN
2995 REM
2996 REM ****************************
2997 REM * KEYBOARD/SETTINGS DISPLAY *
2998 REM ****************************
2999 REM
3000 PRINT"▒▒          ▒                 "
3010 PRINT"▒         ▒ ▒▒▒ ▒ | ▒ ▒ | ▒ ▒ ▒ | ▒▒ "
3020 PRINT  "▒         ▒ ▒▒▒ ▒ | ▒ ▒ | ▒ ▒ ▒ | ▒▒ "

3040 PRINT  "▒         ▒ ▒▒▒ | | | | | | | | | |▒ "
3050 PRINT  "▒         ▒ ▒▒▒▒|▒|-|X||/|\|,|.|/|▒ "
3060 PRINT"▒▒┌──────────────────────────────────┐"
3100 PRINT "|▒▒/▒|-▒▒/   ▒▒ ▒  ▒|▒   ▒▒▒▒▒    ▒▒|   ▒|"
3105 PRINT "├──────────────────┼─────────────────┤"
3110 PRINT "|▒▒IANO         \ +  ▒|▒   ▒IRST      1    ▒|"
3120 PRINT "|▒▒ANJO         \ -  ▒|▒   ▒ECOND     2    ▒|"
3130 PRINT "|▒▒YLOPHONE     \ @  ▒|▒   ▒HIRD      3    ▒|"
3140 PRINT "|▒▒OODWIND      \ *  ▒|▒   ▒OURTH     4    ▒|"
3160 FOR I=1 TO 8
3165 IF IN$(I)="" THEN IN$(I)="▒OT ▒SED"
3170 PRINT "|▒";IN$(I);TAB(14);"←";I;TAB(19);"▒|                 "
3180 NEXT I
3190 PRINT "└──────────────────┴─────────────────┘"
3200 PRINT "▒▒▒▒▒▒▒▒▒"
3210 PRINTTAB(19)"┌──────────────┐"
3220 PRINTTAB(19)"|▒ ▒▒▒▒▒▒▒   ▒▒|  ▒|"
3230 PRINTTAB(19)"├──────────────┤"
3240 PRINTTAB(21)"▒▒AWTOOTH     F1"
3250 PRINTTAB(21)"▒RIANGLE      F3"
3260 PRINTTAB(21)"▒OISE         F5"
3270 PRINTTAB(21)"▒ULSE         F7"
3280 PRINT "▒    ▒RESS '▒▒▒' THEN '▒▒▒' TO RE-DEFINE."
3400 RETURN
```

■

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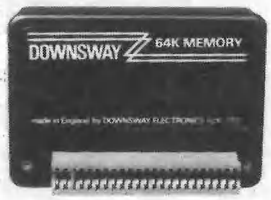

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ALTER	– allows extensive manipulation of the attributes file.
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CLOCK	– controls a digital clock with alarm and alarm-initiated GOSUB facility.
DELETE	– any block of lines.
DO	– DO. . .LOOP structure, with WHILE, UNTIL and EXIT IF.
DPOKE	– double POKE.
EDIT	– a specified line number.
ELSE	– used with IF. . .THEN.
GET	– waits for keyboard entry; doesn't use ENTER.
KEYWORDS	– shifts between new keywords and normal graphics mode.
ON	– GOSUB or GO TO a line number from a list of line numbers.
ON ERROR	– allows trapping of most reports; has available ERROR, LINE and STAT variables.
POP	– removes data from BASIC's stack.
PROC	– named procedures, with DEF PROC and END PROC.
RENUM	– renumber part or whole program with specified start line and increment. Handles GO TO, GOSUB, ON, etc.
ROLL	– pixel movement of part or whole screen in any direction, with wrap-round.
SCROLL	– as ROLL, but without wrap-round.
SORT	– sorts part or all of string or numeric arrays according to specified substring or column. SORT INVERSE sorts in reverse order. One hundred strings can be sorted in about one-fifth of a second!
TRACE	– allows display of line and statement numbers as a program is running. Display of selected variables, single stepping, and reduced speed are also possible.
USING	– used with PRINT; formats numbers.

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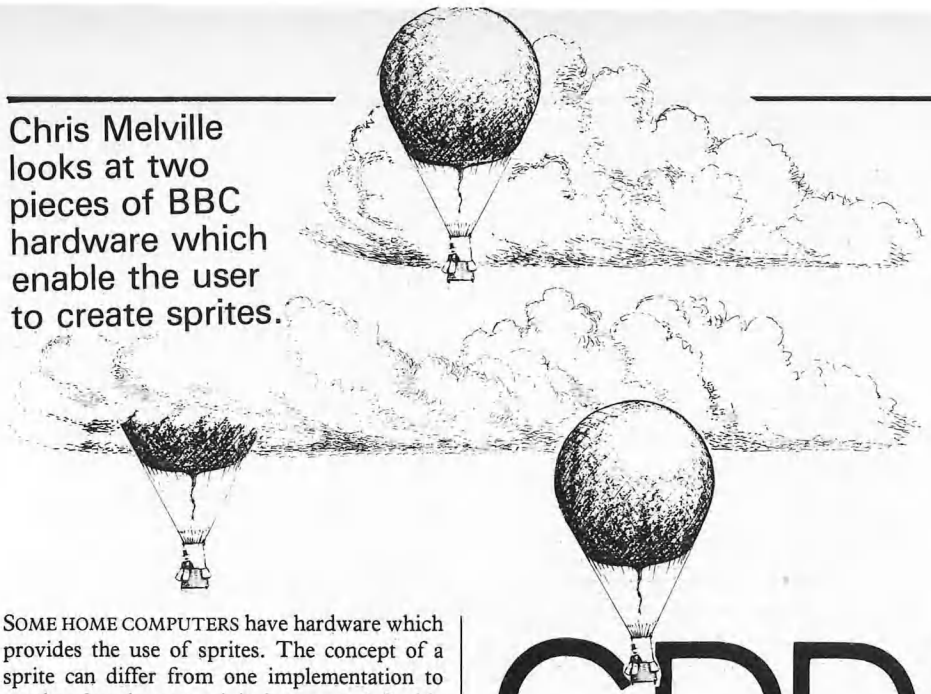
Chris Melville looks at two pieces of BBC hardware which enable the user to create sprites.



SPRITES

SOME HOME COMPUTERS have hardware which provides the use of sprites. The concept of a sprite can differ from one implementation to another but in general it is a user-definable shape which, once defined and positioned on the screen, can be forgotten about until you want to move it — the hardware looks after it in the sense that it handles interaction with other graphics on the screen.

It may or may not, depending on the foreground/background priority of the sprite, allow the sprite to be drawn over — thus the sprite can be made to move in front of or behind other objects on the screen. If you imagine a sprite as being a sticker/transfer which you can stick at will on the front of your screen and subsequently peel it off and reposition it,then you have a fair idea of the nature of sprites.

Some systems allow you to define the sprite's screen velocity. This means that you define its shape, position and velocity and the machine hardware takes it from there. Your sprite will continue to move of its own accord across the screen, passing in front of or behind other graphics in the prescribed manner. Imagine how useful this facility is when writing a space invaders program — define an invader and set it moving, then you can forget about it, unless it reaches the side of the screen or gets hit of course.

The BBC micro was, regrettably, not given the necessary hardware to implement full sprite usage, but that does not mean that all is lost.

The colour palette can be used to make a user-defined shape appear to move in front of or behind selected colours already on the screen. Use will be made here of EOr — exclusive or — printing. The word printing does not imply that the character will only appear at text positions since use will be made of VDUs to link graphics and text cursors and enable the character to appear anywhere on the screen.

The user 6522 VIA will be used to provide regular interrupts, the handler of which will be responsible for providing the automatic moving of the above character. If you are not familiar with 6522s, interrupts or handlers Rodnay Zaks has written an excellent book *Programming the 6502.*

We will be working in mode 2 — 20K and 16 colours — as we need the full 16-colour palette so you will need a Model B, also the user 6522 VIA does not exist on Model A. This is the main reason why some Acornsoft games do not work on As since they make use of the 6522's timers as described later in the article.

MOS issue 0.1 should work since the programs and method deal with 6522 hardware directly, which precludes the use of Tube systems. We could have done the job using the concept of Events rather than interrupts but would have restricted issue 0.1 owners.

Each person's needs are different and it is impossible to provide self-contained bolt-on

(continued on next page)

Figure 1. The Mode 2 colour palette

Number		Physical colour	Logical colour
0		Black	Black
1		Red	Red
2		Green	Green
3		Yellow	Yellow
4		Blue	Blue
5		Magenta	Magenta
6		Cyan	Cyan
7		White	White
8	Flashing	Black/White	Should be redefined as required
9	Flashing	Red/Green	
10	Flashing	Green/Magenta	
11	Flashing	Yellow/Blue	
12	Flashing	Blue/Yellow	
13	Flashing	Magenta/Green	
14	Flashing	Cyan/Red	
15	Flashing	White/Black	

Listing 1.

```
  1REM DEMO1
  10CLS:PRINT"This program shows a simple example of"
'"relative movement using EOR graphics"'"A coloured (r
ed/green) circle is drawn""on the screen and you move
 a white ball"'"about using the cursor keys."'"One of
two things may happen:"
  20PRINT"The ball will only appear in the inner"'"ci
rcle (hit 'I') or it will thread between the sectors (
hit 'S') passing in""front of green on the outside an
d behind it in the inner circle."'''"Hit 'I' or 'S'..."
  30
  40REPEAT:X$=GET$ :UNTIL X$="S" OR X$="I"
  50
  60REM determine which of the available reds will be
 used.
  70IF X$="S" OUTRED=14:INRED=10 ELSE OUTRED=10:INRED
=14
  80MODE2
  90REM. On the outer circle the white ball will pass
 in front of red and behind green (which we will defin
e as colours 10,11 for convenience).
  100REM On the inner circle (here the red is14 and th
e green 15) it will be the other way round.One way of
allocating the logical colours to attain these results
 is:
  110REM white-7,13,8
  120REM red 10,14,9
  130REM green 11,12,15
  140 REM this is now set up:
  150
  160VDU19,13,7;0;19,8,7;0;
  170VDU19,10,1;0;19,14,1;0;19,9,1;0;
  180VDU19,11,2;0;19,12,2;0;19,15,2;0;
  190
  200REM define a 4-character ball.
  210VDU23,240,3,15,31,63,127,127,255,255
  220VDU23,241,255,255,127,127,63,31,15,3
  230VDU23,242,255,255,254,254,252,248,240,192
  240VDU23,243,192,240,248,252,254,254,255,255
  250
  260 REM draw the circles
  270VDU5:PROCCIRCLES
  280X%=500:Y%=500:VX=500:WX=500:GCOL3,7:PROCBALL(500,
500)
  290*FX4,1
  300IF INKEY(-122) X%=X%+16
  310IF INKEY(-26) X%=X%-16
  320IF INKEY(-58) Y%=Y%+16
  330IF INKEY(-42) Y%=Y%-16
  340IF  INKEY(-129) GOTO 300
  350X%=(X%+1280)MOD1280:Y%=(Y%+1024)MOD1024
  360PROCBALL(V%,W%):PROCBALL(X%,Y%)
  370V%=X%:W%=Y%:GOTO300
  380
  390
  400DEF PROCCIRCLES
  410LOCALIX,J%
  420FOR R%=500 TO 200 STEP -300
  430MOVE640+R%,512
  440FORI%=0 TO 340 STEP 20
  450FORJ%=I% TO I%+10 STEP2
  460MOVE640,512:IFR%=200 GCOL0,OUTRED ELSE GCOL0,11
  470PLOT85,640+R%*COSRAD(J%),512+R%*SINRAD(J%)
  480NEXT J%
  490FORJ%=I%+10 TO I%+20 STEP2
  500MOVE640,512:IFR%=500 GCOL0,INRED ELSE GCOL0,15
  510PLOT85,640+R%*COSRAD(J%),512+R%*SINRAD(J%)
  520NEXT J%
  530NEXT I%
  540NEXTR%
  550ENDPROC
  560
  570DEF PROCBALL(X%,Y%)
  580MOVEX%,Y%:VDU240,243
  590MOVEX%,Y%-32:VDU241,242
  600ENDPROC
```

Figure 2. An EOR evaluator for funding X EOR Y

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 ◄— Y
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0	3	2	5	4	7	6	9	8	11	10	13	12	15	14
2	2	3	0	1	6	7	4	5	10	11	8	9	14	15	12	13
3	3	2	1	0	7	6	5	4	11	10	9	8	15	14	13	12
4	4	5	6	7	0	1	2	3	12	13	14	15	8	9	10	11
5	5	4	7	6	1	0	3	2	13	12	15	14	9	8	11	10
6	6	7	4	5	2	3	0	1	14	15	12	13	10	11	8	9
7	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8
8	8	9	10	11	12	13	14	15	0	1	2	3	4	5	6	7
9	9	8	11	10	13	12	15	14	1	0	3	2	5	4	7	6
10	10	11	8	9	14	15	12	13	2	3	0	1	6	7	4	5
11	11	10	9	8	15	14	13	12	3	2	1	0	7	6	5	4
12	12	13	14	15	8	9	10	11	4	5	6	7	0	1	2	3
13	13	12	15	14	9	8	11	10	5	4	7	6	1	0	3	2
14	14	15	12	13	10	11	8	9	6	7	4	5	2	3	0	1
15 ▲ X	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Listing 2.

```
  10 REM DEMO PROGRAM 2
  20 REM FOR £ READ HASH CHARACTER
  30[OPTO
  40\ this program is intended to show how the timer2
 in the model B user 6522VIA can be harnessed to provi
de regular interupts
  50\ and how the user can set up a routine to servic
e these interrupts via the machine operating system.
  60\ In this example program it is the generating of
 the interrupts which is illustrated.The handler will
function only to make a short beep so that the user ca
n tell that interrupts are occuring.
  70\ The next program will show how the handler can
be made to move a 'sprite' around automatically.
  80\IF you time the intervals between the beeps you
may notice a slight deviation in regularity.This is du
e to the clashing of our interrupts with system ones a
nd could be smoothed out by giving our interrupt handl
er first priority.
  100]
  130 PROCinitialise
  150  ?(timer2_high)=10000 DIV256
  160  ?(timer2_low)=10000 MOD256
  180CLS:PRINT''"The interrups are now occurring as yo
u will be able to tell by the pips"
  190PRINT"Try using your machine in the normal way eg
.save the program to tape,list it,type commands etc."
  200PRINT"Unless you take action which results in the
 overwriting of the interrupt handler (in which case t
he machine will crash) the beeps should continue regar
dless."
  230 END
  270DEF PROCinitialise
  280  ACR=&FE6B :REM auxilliary control register
  290  timer2_high=&FE69
  300  timer2_low=&FE68
  310  IER=&FE6E :REM interrupt enable register
  320  INFR=&FE6D :REM interrupt flags register
  350  REM initiate the VIA,create a subroutine that p
roduces a short beep (to be called from the handler),a
nd prepare the handler.
  360  PROCVIA_setup
  370  PROCbeep_setup
  380  PROChandler_setup
  400  REM set the operating systems "user-interrupt"
vector to point to the handler.
  410  ?(&206)=handler MOD 256
  420  ?(&207)=handler DIV 256
  450ENDPROC
  490DEF PROCVIA_setup
  500  REM this procedure sets up various flags so tha
t the 6522 can start timing away as soon as timer2 is
written into.
  520  REM first enable only timer interrupts (both ti
mers are enabled).
  530  ?(IER)=&1F
  540  ?(INFR)=&E0
  550  ?(IER)=&E0
  570  REM now put timer two into "one-shot" mode.
  580  ?(ACR)=?(ACR) AND &BF
  600  ENDPROC
  630DEF PROCbeep_setup
  640  REM this procedure assembles code that will pro
duce a short beep when called with "JSR beep".
  650  REM first set up the parameter block needed for
 the OSWORD call with A=7
  670  param =&70
  680  !(param)=&FFF10011
  690  !(param+4)=&100CB
  710  REM now assemble the code.
  720  DIM beepspace 15
  730  P%=beepspace
  740  [:OPTO
  750  .beep
  760    LDX £param MOD 256
  770    LDY £param DIV 256
  780    LDA £7
  790    JSR  &FFF1
  800    RTS  :]
  820ENDPROC
  870DEF PROChandler_setup
  880  REM this procedure sets up the interrupt handle
r by defining storage bytes(and initialising them),ass
embling the  handler code .
  900  REM first define variable space
  910  count=&78 :every=&79
  920  ?(count)=0:?(every)=0
  940  REM now assemble the code
  950  DIM handler_space 100,X 0,Y 0
  960  FOR pass=0 TO 2 STEP 2
  970  P%=handler_space
  980  [OPT pass
  990  .handler STX X:STY Y  \Save registers
 1000    LDA count            \See if the correct numbe
r of interrupts has occurred
 1010    CLC:ADC £1
 1020    STA count
 1030    CMP every            \This location specifies
how many interrupts should occur between beeps
 1040    BNE ret
 1050    JSR beep
 1060  .ret
 1070    LDA £10000 MOD 256  \Reset the timer.
 1080    STA timer2_low
 1090    LDA £10000 DIV 256
 1100    STA timer2_high
 1110    LDX X:LDY Y:LDA &FC:RTI      :]
 1120  NEXT
 1140ENDPROC
```

(continued from previous page)

procedures to suit every scheme. I will endeavour to spell out the methods that should be used and I give examples to illustrate the potential but it is up to you to apply the technique to your own programs. The submitted examples are well-documented so there should be no problem there.

Colour palette is the name used to describe the relationship between the 16 — in mode 2 — logical colours and the 16 physical colours. Imagine a painter's palette as being a wooden board with 16 pots labelled from black through to flashing black/white. This corresponds to the BBC's set of logical colours. The painter, however, has the choice of what actual paint colours he fills these pots with, and this corresponds to the physical colours on the BBC.

The default is that each paint colour — physical colour — goes into the pot labelled for its logical colour, but this can be changed by VDU19, the syntax of which should be known. Figure 1 serves as a reminder of the 16 colours.

In practice the flashing colours are not used much and we will selectively use VDU19 to replace them so that the steady colours will have alternative numbers that can be used in a GCol statement instead of the usual ones — the reason is EOr plotting.

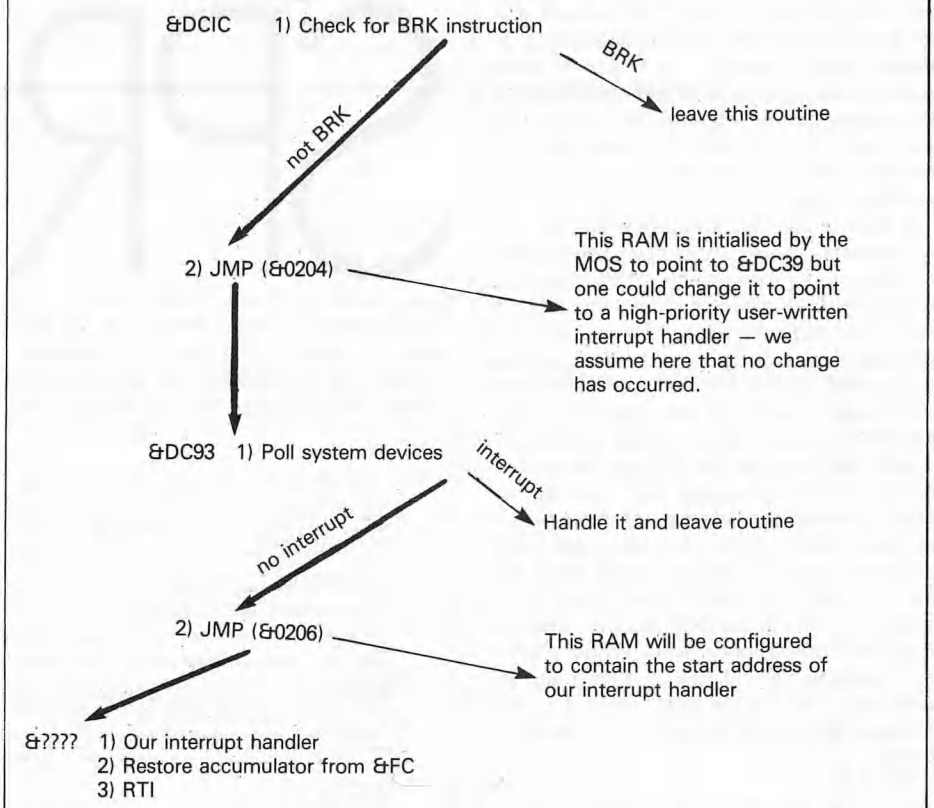
EOr printing: The bitwise logic is amply covered in other issues so I will not repeat it here. Suffice to say that EOr is used because it has the property that, for any two numbers X and Y:

(X EOR Y)EOR Y = X

that is, a number when EOred twice in succession with another number returns to the original value. When applied to graphics — Y is then the logical colour of some printed thing and X is the logical colour it is being printed onto — this has the effect that printing a figure once makes it appear in whatever colour happens to correspond to logical colour number X EOr Y and printing it again at the same place makes it disappear, since all the pixels revert to their original colour numbers.

When animating, the second or erasing step is modified. Instead of printing the same thing at the same place it is shifted a few pixels and, after a bit of arithmetic to compensate for the shift, is printed. Note that the word printing in this context takes for granted that the printing is not the usual superimposing type done under VDU5 but EOr printing. This is selected by choosing the printing colour with the command GCol3 rather than GCol0.

Figure 3. Summary of how MOS issue 1-2 handles interrupts — IRQ.



The dark arrows show the chain of events leading to the movement of the sprite via an interrupt from user VIA Timer 2.

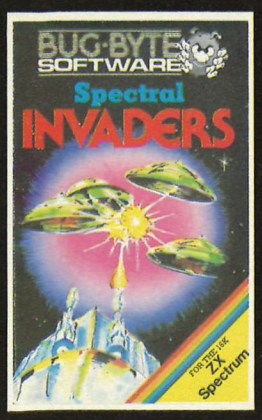
This results in the movement being made smoother but, because the interrupt handler that we will write to move our character must be as a short as possible, we will not use the shifted method but stick with the print-twice-at-the-same-place method.

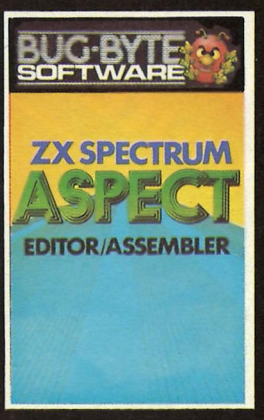
Suppose we have a character which has logical colour X — so when we print it we select the colour with GCol3,X — and there are three logical colours A,B,C already on the screen, we need to know what colour will appear as a result of the EOr action when colour X is printed on each of these colours. Take colour A as an example. If it is true that A EOr X=A then the character will simply not appear when it is printed on anything with colour. This is the basis of having our character moving behind an object. On the other hand suppose that A EOr X = X. Then the character would appear in its required colour and we have foreground motion. It is obviously more likely that A EOr X will be neither A nor X so how can we fiddle this?

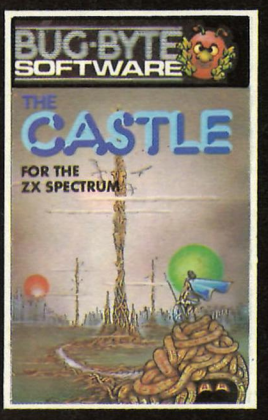
The answer is to manipulate the colour palette so that it does work as required. Take a real example; suppose we want a red character — red=physical colour 1 — to pass in front of a yellow region — yellow=physical colour 3. It can be seen, using figure 2, that 3 EOr 1=2, which is the physical colour number of green, is not what we want. So we perform the preliminary steps:

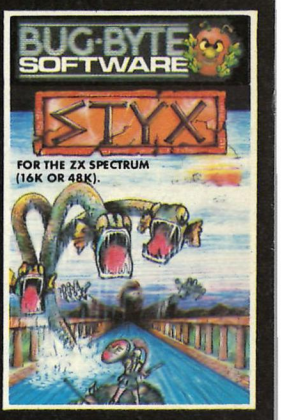
- Define logical colour 8 as red using VDU19,8,1;0;
- Observe that 8 EOr3=11 so also define colour 11 as red by VDU19,11,1;0;
- Print the character in colour 8 by doing GCol3,8 first, it will then appear in colour 11 (8 EOr 3=11) which we have just defined as red. We have thus fiddled the required result, and the character will still disappear when printed again because 8 EOr 11=3 is

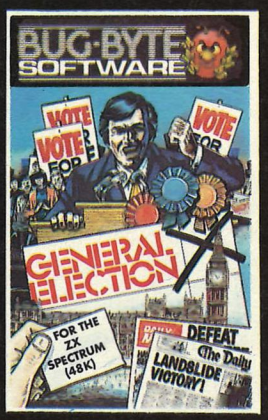
(continued on page 101)

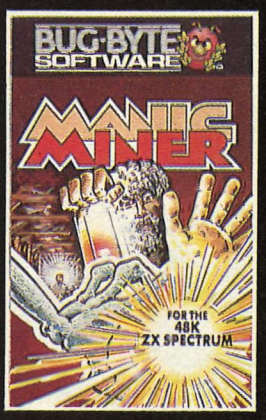












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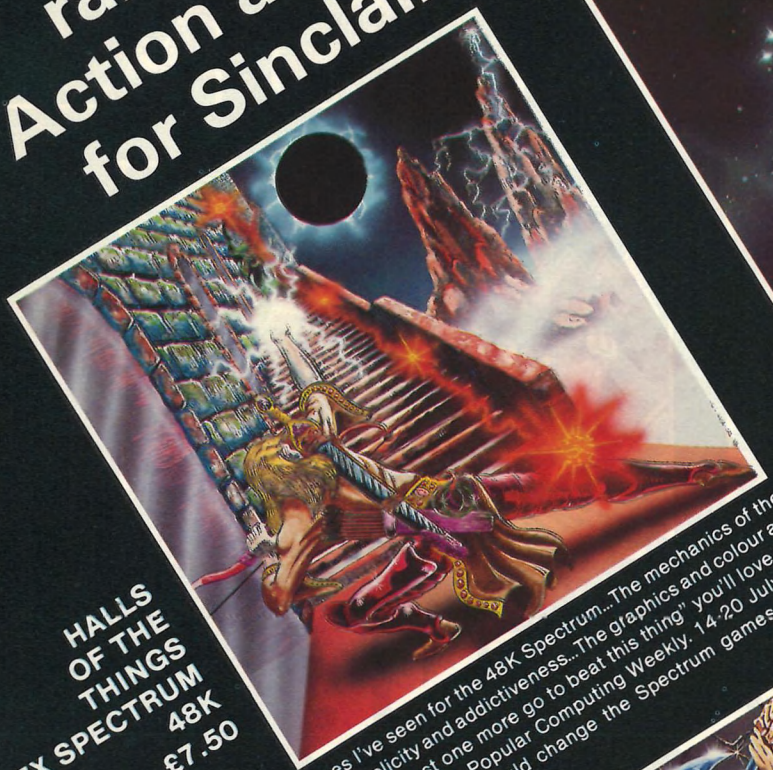

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(continued from page 98)

the original background colour.

We could have picked other numbers to redefine rather than 8 and 11. For example 9 and 10 would do since 9 EOr 3=10. The choice of numbers should be made according to which palette numbers are still unused, bearing in mind that you will probably want your red character to move in front of other colours as well and also behind some colours. The 16 possible pallette colours of mode 2 means that you do this. You will find figure 2 invaluable when choosing your pallette numbers.

Interesting results

Although the above is relatively simple, some interesting results can be obtained as in the demonstration programs. Once you have mastered this technique your future space invaders will have the power to move behind cover for added protection.

The next section deals with the automatic movement of characters using the user 6522 VIA timers to generate regular interrupts and must therefore get a little technical.

As previously mentioned, not all MOS issues support the ability to generate events every few fractions of a second. It is necesary, therefore, to get right down to the hardware and start using the hardware timers on the user 6522 VIA.

If you are already familiar with the workings of the 6522 you can skip the following description, albeit brief.

The 6522 VIA or Versatile Interface Adapter, is a chip specifically intended for use with 65** series chips, of which the 6502 microprocessor is a member. It provides the microprocessor with facilities it does not have on-board such as two interval/pulse timers, a shift register, I/O ports with handshaking, etc. The BBC MOS has one for its own exclusive use, for example, the interfacing of the 6502 to system hardware such as the keyboard. There is also a user-dedicated one.

It is our objective to use one of the two timers on the user 6522 to generate an interrupt every-so-often. We will set up the interrupt handler to move our sprite by a certain number of pixels in the x,y directions every time an interrupt occurs. The first thing we have to know, then, is how the BBC Computer deals with interrupts of the IRQ variety — NMIs should be avoided.

The 6502 microprocessor, on receipt of a low-active IRQ and assuming these are not disabled, will finish what it is doing, Save various things on the stack and then vector via &FFFE, &FFFF. In the BBC this is part of the MOS ROM and for issue 1.2 MOS the address held at these locations is &DCIC. So the net effect of an IRQ is a jump to &DCIC, where the MOS's handling routine begins.

The action then taken is as shown in figure 3. We will change the vector at &0206 to point to our handler so that, on receipt of an interrupt it does not recognise — which the one from the user 6522 is — the MOS causes its execution.

Check for spurious IRQs

Our handler must begin by checking for spurious IRQs just to be on the safe side. It does this by examining the relevant bit in the 6522's Interrupt Flag Register — at &FE6D as in figure 4 — which indicates if the timer was the cause of the interrupt. Thus, having decided how the timer's interrupts will be handled, we now need to get it to generate them in the first place. The first step is to enable timer 2's interrupts by setting the appropriate bit in the 6522's interrupt enable register — see figure 4 part b. We want to use timer 2 — the simplest of the two timers — in one-shot clocked mode. This means that once you set it going — which occurs automatically when you write a start value into it — it counts down clock pulses until it reaches zero. It then generates an interrupt, indicating this by setting the bit in the Interrupt Flag Register. It is left to the handler to restart the timer. This also cancels the IFR's flag.

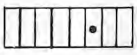
Timer is two bytes wide

We can configure timer 2 to the one-shot clocked mode by setting bit five of the 6522's Auxiliary Control Register.

Note that the timer is only two bytes wide and, since it decrements at clock frequency, can only time very short intervals. For this reason the interrupt handler will not move the sprite every time it is entered but only every so often.

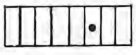
Figure 4. The relevant 6522 registers.

a) Interrupt Flag Register — &FE6D.



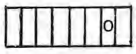
This bit indicates an interrupt from timer 2

b) Interrupt Enable Register — &FE6E.



To enable T2 interrupts,

c) Auxiliary Control — FE6B Register

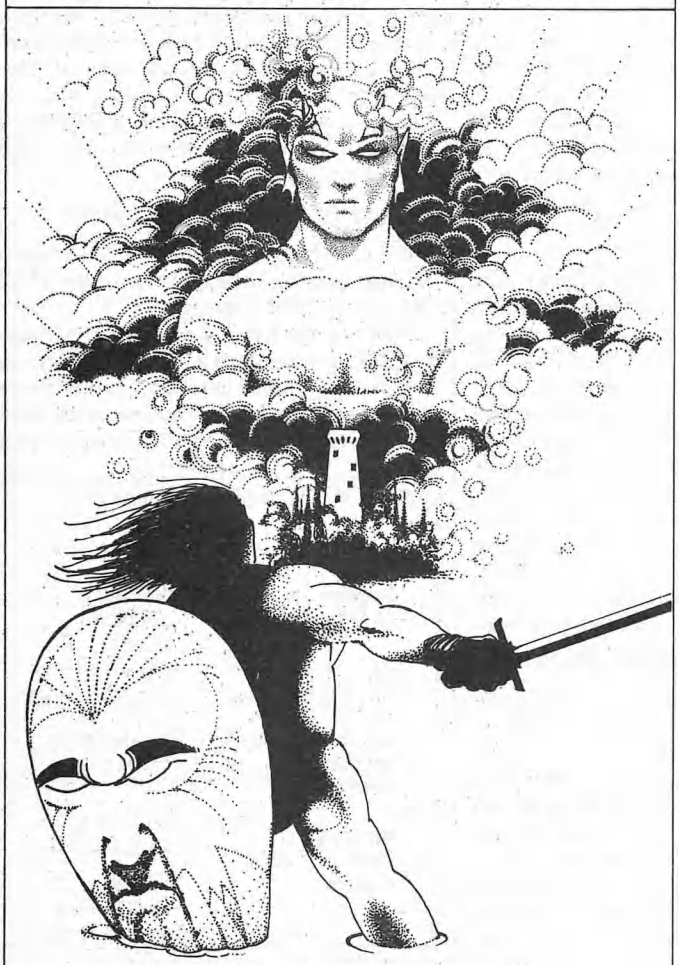


Selects "Free Running" Mode for Timer 2

Listing 3.

```
  10 REM DEMO PROGRAM 3
  30[OPTO
  40\ this program is intended to show how the timer2
 in the model B user 6522VIA can be harnessed to provi
de regular interrupts
  50\ and how the user can set up a routine to servic
e these interrupts via the machine operating system.
  60\ In this example,these interrupts will be respon
sible for moving a character across the screen.The scr
een will be split into two windows,the character movem
ent will take place in the top window and the text cur
sos will be in the lower.
  70\The user can continue to use the facilities offe
red by the computer without it affecteing the 'sprite'
 movement.
  80]
  100 MODE 2
  110 PROCinitialise
  130PRINT"Now play with the computer,eg write a small
 program or SAVE this one.You will see that it behaves
 as if nothing was happening unless you try to scroll
the screen in which case it will crash."
  140PRINT"This is due to the software scrolling and t
he graphics above interacting."
  160  ?(timer2_high)=13000 DIV256
  170  ?(timer2_low)=13000 MOD256
  210 END
  250DEF PROCinitialise
  260   ACR=&FE6B :REM auxilliary control register
  270   timer2_high=&FE69
  280   timer2_low=&FE68
  290   IER=&FE6E :REM interrupt enable register
  300   INFR=&FE6D :REM interrupt flags register
  330  REM initiate the VIA,create a subroutine that w
ill move the sprites (to be called from the handler),a
nd prepare the handler.
  340  PROCVIA_setup
  350  PROCmove_setup
  360  PROChandler_setup
  380  REM set the operating systems "user-interrupt"
vector to point to the handler.
  390  ?(&206)=handler MOD 256
  400  ?(&207)=handler DIV 256
  420  REM SET UP THE SCREEN ETC.
  430  PROCsetscreen
  450ENDPROC
  490DEF PROCVIA_setup
  500  REM this procedure sets up various flags so tha
t the 6522 can start timing away as soon as timer2 is
written into.
  520  REM first enable only timer interrupts (both ti
mers are enabled).
  530  ?(IER)=&1F
  540  ?(INFR)=&E0
  550  ?(IER)=&E0
  570  REM now put timer two into "one-shot" mode.
  580  ?(ACR)=?(ACR) AND &BF
  600  ENDPROC
  670DEF PROChandler_setup
  680  REM this procedure sets up the interrupt handle
r by defining storage bytes(and initialising them),ass
embling the  handler code .
  700  REM first define variable space
  710  count=&7B :every=&79
  720  ?(count)=0:?(every)=3
  740  REM now assemble the code
  750  DIM handler_space 100
  760  FOR pass=0 TO 2 STEP 2
  770  P%=handler_space
  780  [OPT pass
  790  .handler PHA:TXA:PHA:TYA:PHA \Save registers
  800    LDA count            \See if the correct numbe
r of interrupts has occurred
  810    CLC:ADC £1
  820    STA count
  830    CMP every            \This location specifies
how many interrupts should occur between beeps
  840    BNE ret:LDA £0 :STA count
  850    JSR move
  860  .ret
  870    LDA £13000 MOD 256  \Reset the timer.
  880    STA timer2_low
  890    LDA £13000 DIV 256
  900    STA timer2_high
  910    PLA:TAY:PLA:TAX:PLA:RTI:]
  920  NEXT
  930ENDPROC
  960DEF PROCsetscreen
  970 REM this procedure sets up a mode 2 screen,toget
her with necessary EOR colour definitions so that the
interrupt handler can move a sprite on it.
  980
  990REM first do the colour definitions according to
the following scheme:
  1000RFM 1) The screen will be in cyan/blue stripes.
  1010REM 2) There will be two  sprites  of colours red
 (a slow mover) and yellow (faster).These will move ov
er the stripes as follows:
  1020REM    a) The red moves over the cyan stripes and
behind the blue ones.
  1030REM    b) The yellow moves over the blue stripes a
nd behind the cyan ones.
  1040REM This is acheived by redefining the palette th
us (use your EOR table to  check):
  1050REM   BLUE-logical 4,10
  1060REM   CYAN-logical 8,11
  1070REM   YELLOW-logical 3,9
  1080REM   RED-logical 5,14
  1090
  1100VDU19,10,4;0;
  1110VDU19,11,6;0;
  1120VDU19,8,6;0;
  1130VDU19,9,3;0;
  1140VDU19,5,1;0;
  1150VDU19,14,1;0;
  1170REM define a walking man character in three walki
ng positions
  1180VDU 23,240,28,28,8,8,28,8,8,8
  1190VDU 23,241,28,28,8,28,8,20,20,20
  1200VDU 23,242,28,28,8,127,8,20,34,65
  1220REM now set up the screen.
  1230FOR IX=0 TO 1280 STEP 128
  1240  IF IXMOD256=0 GCOL0,10 ELSE GCOL0,11
  1250  MOVE IX,768
  1260  MOVE IX,1024
  1270  PLOT85,IX+128,1024
  1280  MOVE IX+128,768
  1290  PLOT85,IX,768
  1300NEXT
  1310VDU23;11,0;0;0;0;COLOUR5
  1320VDU4,28,0,31,19,8
  1330VDU24,0;0;1280;750;
  1340 ENDPROC
  1370DEF PROCmove_setup
  1380DIM room 400
  1390REM also reserve room for the variables that are
needed (it is necessary for the interrupt handler to r
emember the characters positions)
  1400DIM rxl 0,rxh 0,yxh 0,yxl 0
  1410?(rxl)=0:?(rxh)=5:?(yxh)=5:?(yxl)=0
  1420lm=&7A:nm=&7B :REM zero_page variables
  1430?(lm)=240 :REM the first man to be printed
  1440OSWRCH=&FFEE
  1450FOR pass=0 TO 2 STEP 2:P%=room
  1460[OPT pass
  1470
  1480\ First join graphics and text cursors and work o
ut which of the three man-positions is to be printed n
ext.
  1490.move LDA £5 :JSR OSWRCH
  1500      LDA lm :STA nm:CLC:ADC £1
  1510      CMP £243 :BNE m1
  1520      LDA £240
  1530.m1   STA lm
  1540      \now do a GCOL and then move the graphics c
ursor to where the last green man was.
  1550      LDA £18:JSR OSWRCH
  1560      LDA £3:JSR OSWRCH
  1570      LDA £14:JSR OSWRCH
  1590      LDA £25:JSR OSWRCH
  1600      LDA £4:JSR OSWRCH
  1610      LDA rxl:JSR OSWRCH
  1620      LDA rxh:JSR OSWRCH
  1630      LDA £182:JSR OSWRCH
  1640      LDA £3:JSR OSWRCH
  1650     \now work out new x-position of man
  1670     LDA rxl:CLC:ADC£8:STA rxl
  1680     BCC m2
  1690     LDA rxh:CLC:ADC £1:STA rxh
  1700     CMP £6:BNE m2  \check for end of line
  1710     LDA £0:STA rxh
  1730.m2 LDA nm:JSR OSWRCH \overwrite last man
  1740     LDA £25:JSR OSWRCH
  1750     LDA £4:JSR OSWRCH
  1760     LDA rxl:JSR OSWRCH
  1770     LDA rxh:JSR OSWRCH
  1780     LDA £182:JSR OSWRCH
  1790     LDA £3:JSR OSWRCH
  1810     LDA lm :JSR OSWRCH
  1820\NOW REPEAT ALL OF THE ABOVE CODE FOR THE SECOND
(YELLOW) CHARACTER,LOOPING IS NOT USED FOR REASONS OF
SPEED.
  1840      LDA £18:JSR OSWRCH
  1850     LDA £3:JSR OSWRCH
  1860     LDA £3:JSR OSWRCH
  1870     LDA £25:JSR OSWRCH
  1880     LDA £4:JSR OSWRCH
  1890     LDA yxl:JSR OSWRCH
  1900     LDA yxh:JSR OSWRCH
  1910     LDA £82:JSR OSWRCH
  1920     LDA £3:JSR OSWRCH
  1930    LDA yxl:CLC:ADC£16:STA yxl
  1940    BCC n2
  1950    LDA yxh:CLC:ADC £1:STA yxh
  1960    CMP £6:BNE n2
  1970    LDA £0:STA yxh
  1980.n2 LDA nm:JSR OSWRCH
  1990    LDA £25:JSR OSWRCH
  2000    LDA £4:JSR OSWRCH
  2010    LDA yxl:JSR OSWRCH
  2020    LDA yxh:JSR OSWRCH
  2030    LDA £82:JSR OSWRCH
  2040    LDA £3:JSR OSWRCH
  2050    LDA lm:JSR OSWRCH
  2080    LDA £4:JSR OSWRCH \return to cursors seperate
mode
  2090    RTS
  2100]:NEXT
  2110ENDPROC
```

SPECTRUM 48K : ZX81 16K SIX PART ADVENTURE



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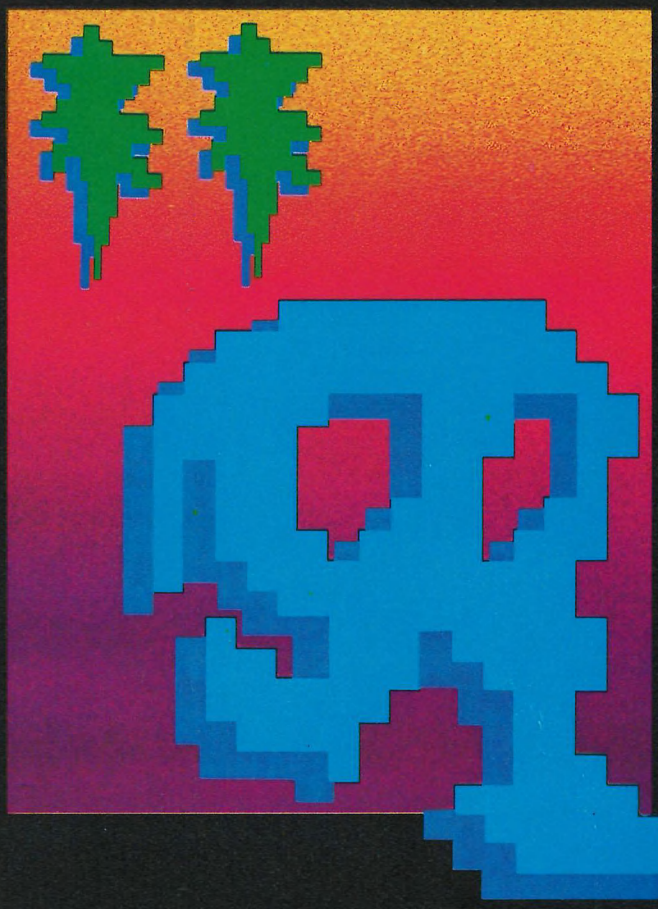

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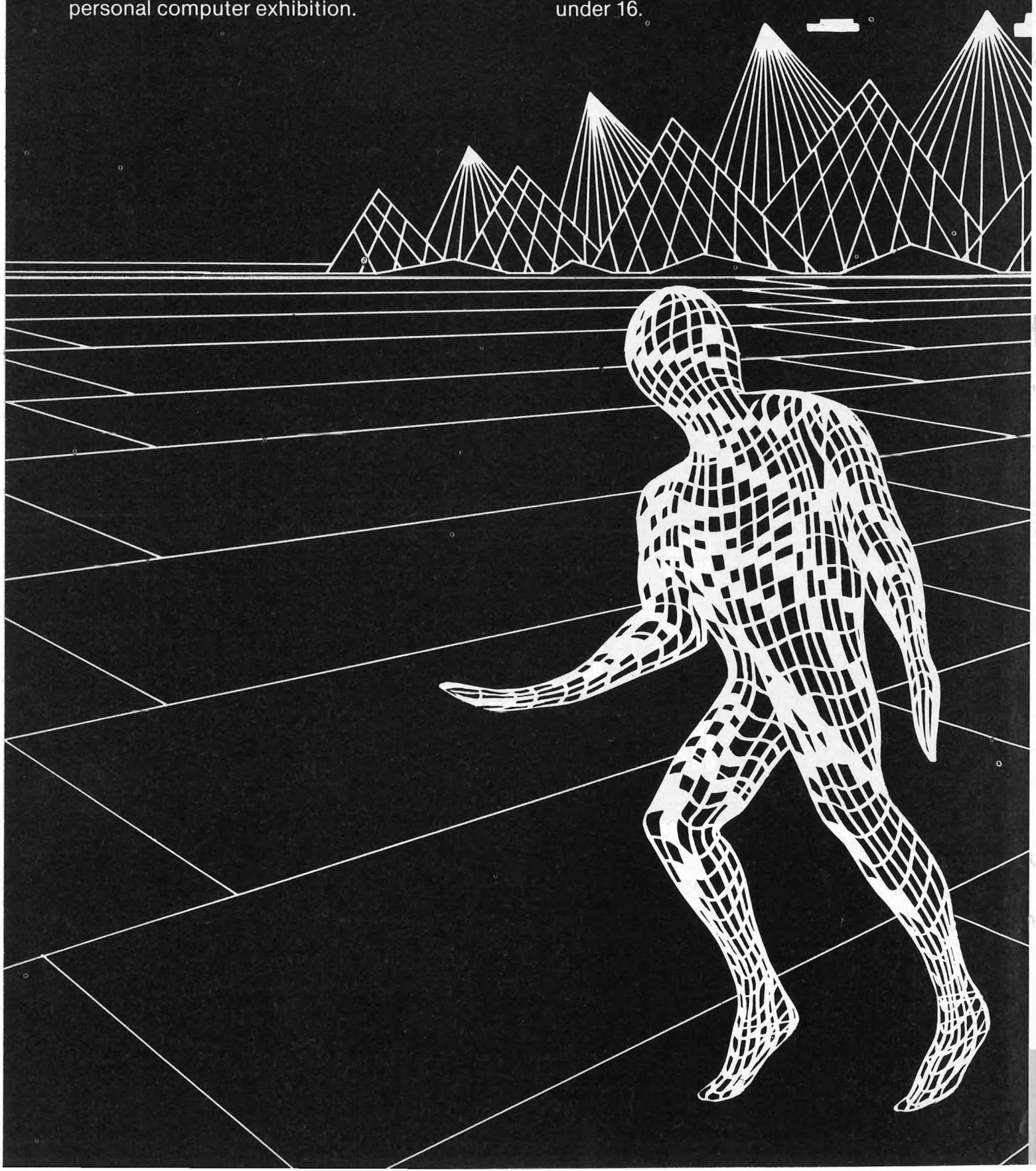

Travelling to the show is also easy as the organisers have arranged special reduced-price tickets with British Rail which include the cost of admission. For further information ring British Rail Enquiry Bureau on 061-832-8353 before November 11.

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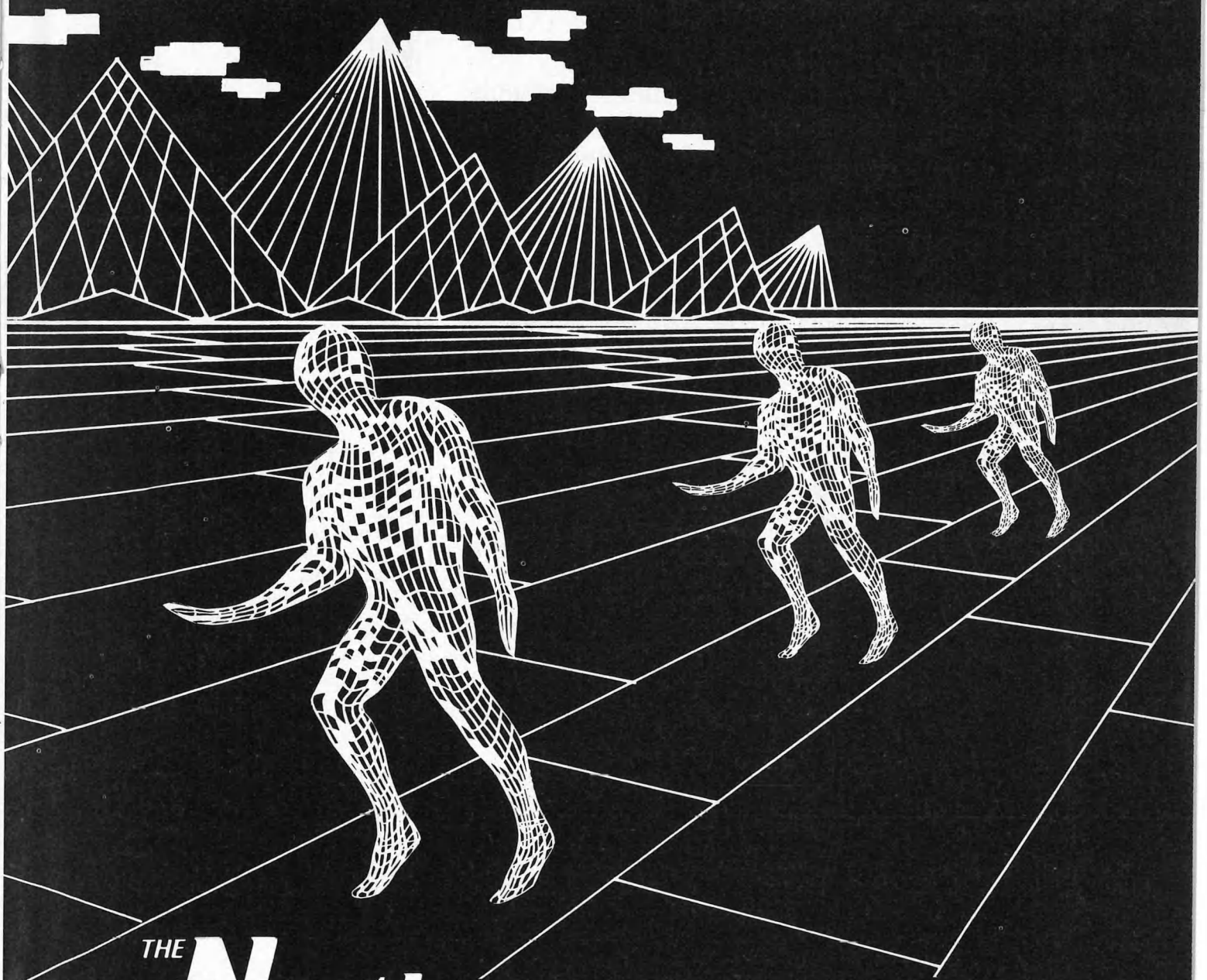

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SLIDING PUZZLE

Amuse yourself and your kids with sliding puzzles by Margaret Norman.

THE DRAGON HAS an excellent range of graphics commands, which makes it possible to produce quite elaborately coloured pictures with the minimum of programming. Unfortunately, these have been under-used in most published programs. There are two main reasons for this: the difficulty of mixing text with high-resolution graphics, and the slow speed at which some of the graphics commands, particularly the Paint command, are executed.

This program, which is the Dragon version of a children's sliding tile puzzle, uses virtually all the high-resolution graphics commands to produce a very colourful game. There is a choice of three different puzzle designs; a small guide picture is shown as well as the main puzzle picture, and the player's input — row letter and column number — and number of moves taken are also shown on screen. All this in just 180 lines of program.

The program starts with a short title sequence — lines 50 to 150 — the letters of the word Sliding slide into position from the right-hand edge of the screen, then Picture and Puzzles are printed underneath against a blue background. This is followed by the selection of the puzzle to be used — lines 170 to 190. The instructions come after this so that the first line of the instructions can be selected to match the puzzle chosen.

Strings are defined near the start of the program — lines 280 to 310 — to Draw the digits 0 to 9. This has to be done before the program branches to draw the appropriate puzzle picture, as the digits are used for the number puzzle.

All three puzzles are drawn in Pmode 3 using the green/yellow/blue/red colour set, against a yellow background with red lettering. The designs have all been planned so that when they are divided up into four rows of four squares, the top left-hand square will be plain blue. This square represents the empty tile position.

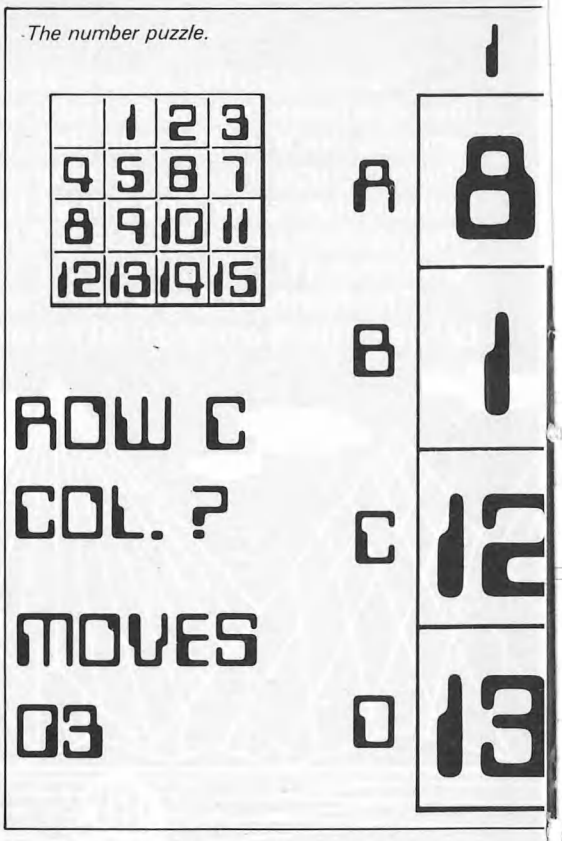
The first puzzle is drawn in lines 1060 to 1190 and shows a yellow house, with red roof and door, against a blue sky and green grass. The outlines of the picture are drawn using the string, HS, defined in line 1080. This string is used for both the main picture and the small guide picture, with different scale factors — S16 and S4 — in the Draw command.

The smoke coming out of the chimney of the house is Drawn separately for the two pictures, as a simplified version is used for the small picture. The squares containing the pictures are both initially Painted green, as the picture contains more pieces in green than in any other colour; the curtains at the windows of the house are green. The other coloured pieces are Painted after the outlines have been drawn.

For the second puzzle — the number puzzle — the two squares are initially Painted blue, then the picture squares are divided up into small squares, using the Line command, and alternate small squares are Painted red. The numbers 1 to 15 are then Drawn on these squares in yellow. The pre-defined strings are used to Draw the numbers 1 to 9, but the numbers 10 to 15 are Drawn separately — lines 1320, 1330 and 1370 — as they can only just be made to fit in the squares in the small picture without becoming illegible.

The final puzzle is of a yellow Humpty Dumpty, with green hat and trousers, sitting on a red wall. Humpty's body is drawn with the Circle command, with a 1:3 height-to-width ratio — lines 1440, 1530. The Circle command is also used for Humpty's mouth, but here only half the ellipse is drawn — line 1480. Circles are also used for the eyes in the big picture, but Pset is used instead in the small picture — line 1570 — as circles with small radii look like crosses.

The arms and legs are Drawn and Painted in detail in the big picture, but are just represented by lines in the small one. The bricks on the wall have only been drawn in the big picture.



The number puzzle.

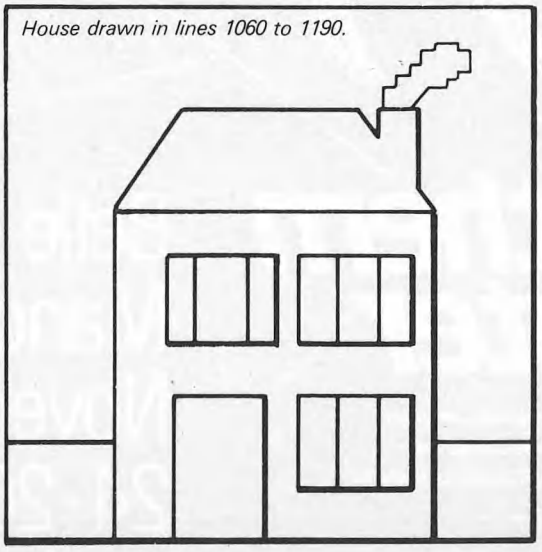
The screen is not set until after the puzzle has been drawn, so that the picture will appear all at once instead of bit-by-bit. A Please Wait message is displayed on the screen while the puzzle is being drawn — line 270. If you would prefer to see the picture being drawn, change line 270 to:

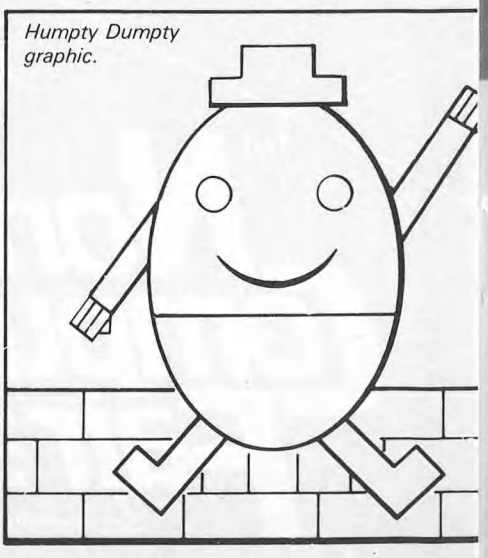
```
270 PMODE3,1:PCLS2:SCREEN1.0
```

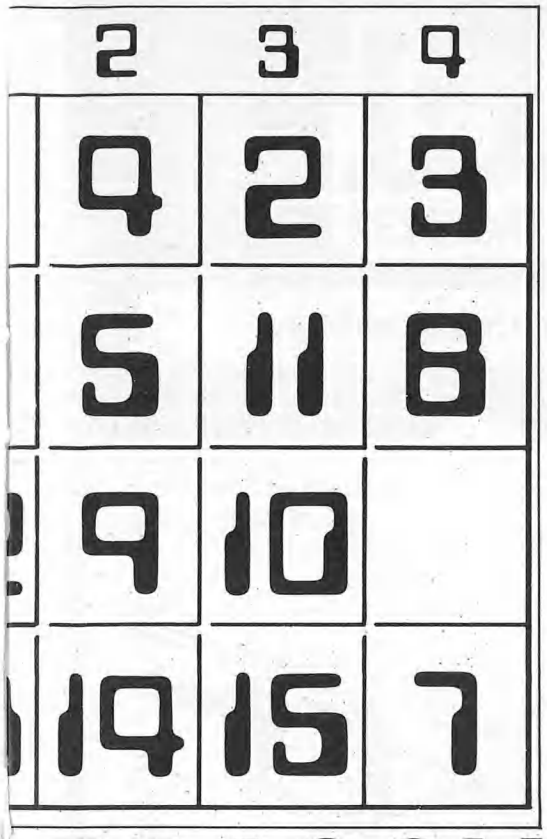
and omit lines 1070, 1210 and 1410. If you would prefer the picture not to appear until it has been shuffled by the computer, delete line 370 and insert

```
495 SCREEN1,0
```

The Get and Put commands are used to move the puzzle pieces. The plain blue square is held in array B, and the picture piece being moved in array A. Note that these are both one-dimensional arrays; two dimensional arrays, as described in the Dragon manual, are not necessary. To calculate the array size


House drawn in lines 1060 to 1190.


Humpty Dumpty graphic.



DRAGON

needed to Get(X1,Y1)-(X2,Y2) in this Pmode, use the formula (X2-X1)*(Y2-Y1)/8.

The number of moves made by the computer depends on the level of difficulty selected. At the lower levels of difficulty, the computer may occasionaly shuffle the picture back to where it started. If this happens you must move one piece out of position then back again, as the computer does not check to see if the puzzle is complete until after the player has made a move. At level five the picture should be pretty well mixed up.

When the player is required to input a row letter or column number, a question mark will appear after the word Row or Col on the screen. Get and Put are used here too, for the question mark and the blank array BQ — which is also used to blank out the number of moves — but the numbers and letters are Drawn using previously defined strings. The number of moves the player can make is limited to 100, mainly because the subroutine which Draws the number — lines 1000-1050 — can only handle two-digit numbers.

The puzzle picture is copied before the game starts — in line 380 — so that it need not be re-drawn for subsequent games. If you want to change to a different puzzle, you must stop the program and run it again. If you would like to leave more memory space to add other pictures of your own, then omit line 380, change the 8 in line 30 to 4, omit line 830 and change line 900 to End. You will then only be asked if you want another game if you have successfully solved the puzzle.

Anyone trying to adapt this program to run on a different computer may hit problems because so many of the graphics commands used are specific to the Dragon.

List of variables.

Q(I):	array used for question mark
BQ(I):	array used to blank out question mark
B(I):	array used for blank blue square
A(I):	array used for picture square
Z:	counter used for sounds in title sequence
I,J:	loop counters
A$:	letter to be Poked onto screen
A:	ASCII value of letter
DL:	delay loop counter
K:	indicates puzzle chosen
L:	level of difficulty
N$(I):	strings to Draw digits
P(I,J):	number of picture piece in square (I,J)
BC,BR:	column and row nos. of blank piece
W,W1:	used to select piece to be moved by computer
C,R:	column and row nos. of piece to be moved
M:	number of moves taken
F:	flag indicating whether puzzle was completed
XA,YA:	X and Y co-ordinates of corner of piece to be moved
XB,YB:	X and Y co-ordinates of corner of blank piece
D1,D2:	digits in M
H$:	string to Draw house
L$(I):	strings to Draw letters A-D

```
10 REM SLIDING PICTURE PUZZLE
20 REM BY MARGARET NORMAN
30 CLEAR 500:PCLEAR 8
40 DIM Q(10),BQ(20),B(200),A(200)
50 CLS3
60 Z=200
70 FOR I=1 TO 7
80 READ A$:A=ASC(A$)
90 FOR J=1 TO(18-I)
100 POKE (1024+254-J),175:POKE(1024+253-J),A
110 NEXT J
120 SOUNDZ,1:Z=Z-5
130 NEXT I
140 PRINT@268,"PICTURE";:PRINT@300,"PUZZLES";
150 DATA S,L,I,D,I,N,G
160 FOR DL=0 TO 1500:NEXT
170 CLS:PRINT@40,"PUZZLES AVAILABLE:":PRINT@98,"(1)  H
OUSE":PRINT@162,"(2)  NUMBERS":PRINT@226,"(3)  HUMPTY
DUMPTY"
180 PRINT:INPUT"WHICH WOULD YOU LIKE (1,2 OR 3)";K
190 IF K<1 OR K>3 THEN 180
200 ON K GOTO 210,220,230
210 CLS:PRINT:PRINT"REARRANGE THE PIECES TO FORM A  PI
CTURE OF A HOUSE.":GOTO 240
220 CLS:PRINT:PRINT"ARRANGE THE NUMBERS IN THE ORDERSH
OWN IN THE SMALL PICTURE":GOTO 240
230 CLS:PRINT:PRINT"CAN YOU PUT HUMPTY TOGETHER     AG
AIN?"
240 PRINT"TO MOVE A PIECE ADJACENT TO THE EMPTY (PLAIN
 BLUE) POSITION,     TYPE THE ROW LETTER THEN THE     CO
LUMN NUMBER."
250 PRINT:INPUT"LEVEL OF DIFFICULTY (1-5)";L
260 IF L<1 OR L>5 THEN 250
270 CLS:PRINT@265,"PLEASE WAIT"
280 REM NUMBERS
290 N$(0)="R6D8L6UBBR10":N$(1)="BR2R2D8L2R4BR4BU8":N$(
2)="R6D4L6D4R6BR4BU8"
300 N$(3)="R6D4NL6D4L6BR10BU8":N$(4)="D6R4NU2ND2R2BR4B
U6":N$(5)="NR6D4R6D4L6BR10BU8"
310 N$(6)="DBR6U4L6BR10BU4":N$(7)="R6DBBR4BU8":N$(8)="
R6D4NL6D4L6UBBR10":N$(9)="NR6D4R6U4DBBR4BU8"
320 ON K GOTO 1060,1200,1400
330 FOR I=1 TO 4:FOR J=1 TO 4
340 P(I,J)=I+(J-1)*4
350 NEXT J,I
360 BC=1:BR=1
370 SCREEN1,0
380 PCOPY 1 TO 5:PCOPY2 TO 6:PCOPY3 TO 7:PCOPY4 TO 8
390 REM SHUFFLE PICTURE
400 FOR I=1 TO (L*10)
410 W=RND(4):IF (W=1 AND W1=2) OR (W=2 AND W1=1) OR(W=
3 AND W1=4) OR(W=4 AND W1=3) THEN 410
420 W1=W    :ON W1 GOTO 430,440,450,460
430 C=BC:IF BR=1 THEN R=BR+1:GOTO 470 ELSE R=BR-1:GOTO
 470
440 C=BC:IF BR=4 THEN R=3:GOTO 470 ELSE R=BR+1:GOTO 47
0
450 R=BR:IF BC=1 THEN C=2:GOTO 470 ELSE C=BC-1:GOTO 47
0
460 R=BR:IF BC=4 THEN C=3 ELSE C=BC+1
470 GOSUB 910
480 NEXT I
490 SOUND200,5
500 REM START GAME
510 PUT(56,80)-(76,88),BQ,PSET
520 PUT(56,100)-(76,108),BQ,PSET
530 PUT(56,80)-(66,88),Q,PSET
540 R$=INKEY$:IF R$="" THEN 540
550 R=ASC(R$)-64:IF R<1 OR R>4 THEN 540
560 PUT(56,80)-(76,88),BQ,PSET
570 DRAW"BM56,80;XL$(R);"
580 PUT(56,100)-(66,108),Q,PSET
590 C$=INKEY$:IF C$="" THEN 590
600 C=VAL(C$):IF C<1 OR C>4 THEN 590
610 PUT(56,100)-(76,108),BQ,PSET
620 DRAW"BM56,100;XN$(C);"
630 IF(R=BR AND ABS(C-BC)=1) OR(C=BC AND ABS(R-BR)=1)
THEN GOSUB 910:GOTO 650
640 GOTO 510
650 SOUND200,2
660 M=M+1:IF M>99 THEN 870
670 GOSUB 1000
680 REM CHECK FOR PUZZLE COMPLETE
690 FOR I=1 TO 4
700 FOR J=1 TO 4
710 IF P(I,J)<>I+(J-1)*4 THEN 500
720 NEXT J,I
730 REM PUZZLE COMPLETE
740 FOR I=1 TO 3:SOUND170,2:SOUND200,4:NEXT I:FOR DL=0
 TO 500:NEXT
750 CLS:PRINT@235,"WELL DONE!"
760 PRINT@291,"YOU SOLVED IT IN";M;"MOVES"
770 PRINT@354,"(IT WAS SHUFFLED";L*10;"TIMES)"
780 PRINT@425,"ANOTHER GO (Y/N)";:INPUT Q$
790 IF Q$="N" THEN 860
800 CLS:INPUT"LEVEL OF DIFFICULTY (1-5)";L
810 IF L<1 OR L>5 THEN 800
820 PMODE3,1:SCREEN1,0
830 IF F=1 THEN PCOPY 5 TO 1:PCOPY 6 TO 2:PCOPY 7 TO 3
:PCOPY 8 TO 4:BR=1:BC=1:F=0
840 M=0:GOSUB 1000
850 GOTO 390
860 END
870 REM FAIL
880 SOUND50,3:FOR DL=0 TO 300:NEXT
890 CLS:PRINT@229,"SORRY - YOU FAILED TO SOLVE THE PUZ
ZLE IN 100 MOVES"
900 F=1:GOTO 780
910 REM SLIDE PIECE(R,C)
920 XA=40+40*C:YA=16+(R-1)*40
930 GET(XA,YA)-(XA+40,YA+40),A,G
940 XB=40+40*BC:YB=16+(BR-1)*40
950 PUT(XB,YB)-(XB+40,YB+40),A,PSET
960 PUT(XA,YA)-(XA+40,YA+40),B,PSET
970 P(BR,BC)=P(R,C):P(R,C)=1
980 BR=R:BC=C
990 RETURN
1000 REM WRITE NO. OF MOVES
1010 D1=INT((M+0.01)/10)
1020 D2=M-10*D1
1030 PUT(25,155)-(45,163),BQ,PSET
1040 DRAW"BM25,155;XN$(D1);XN$(D2);"
1050 RETURN
1060 REM DRAW PICTURE
1070 PMODE3,1:PCLS2
1080 H$="R6U6NL6U18E10R8F4U4R4DBH4F6NL2BD18NR6D6L18U10
L6D10R6L10U16BR4U6R2ND6R4ND6R2D6LBBR12U6R2ND6R4ND6R2D6
LBBD6R2ND6R4ND6R2D6LBU6"1090 LINE(16,16)-(56,56),PSET,
B:PAINT(18,18),1,4
1100 DRAW"BM16,56;XH$;BM44,22;U2R4U2R4D4LBD2"
1110 PAINT(18,18),3,4:PAINT(24,40),2,4:PAINT(28,50),4,
4
1120 PAINT(40,30),4,4:PAINT(46,24),4,4:PAINT(46,20),2,
4
1130 PAINT(30,40),3,4:PAINT(42,40),3,4:PAINT(42,50),3,
4
1140 LINE(80,16)-(240,176),PSET,B:PAINT(82,18),1,4
1150 DRAW"BM80,176;S16;XH$;S4;BM196,40;U4E4R4E4R4E4R4F
4D4L4G4LBG4;BM136,152;R4D4L4U4"
1160 PAINT(82,18),3,4:PAINT(112,160),2,4:PAINT(160,50)
,4,4
1170 PAINT(200,50),4,4:PAINT(198,38),2,4:PAINT(128,160
),4,4
1180 PAINT(136,100),3,4:PAINT(184,100),3,4:PAINT(184,1
50),3,4
1190 GOTO 1610
1200 REM DRAW NUMBER PUZZLE
1210 PMODE3,1:PCLS2
1220 LINE(16,16)-(56,56),PSET,B:LINE(80,16)-(240,176),
PSET,B
1230 PAINT(18,18),3,4:PAINT(82,18),3,4
1240 FOR I=1 TO 4
1250 LINE(16+10*I,16)-(16+10*I,56),PSET:LINE(16,16+10*
I)-(56,16+10*I),PSET
1260 LINE(80+40*I,16)-(80+40*I,176),PSET:LINE(80,16+40
*I)-(240,16+40*I),PSET:NEXT I
1270 FOR I=1 TO 2:FOR J=1 TO 2
1280 PAINT(8+20*I,20*J-2),4,4:PAINT(20*I- 2,8+20*J),4,
4
1290 PAINT(50+80*I,80*J-60),4,4:PAINT(80*I+10,80*J-20)
,4,4
1300 NEXT J,I
1310 DRAW"BM28,18;C2"+N$(1)+N$(2)+N$(3)+"BM18,28;"+N$(
4)+N$(5)+N$(6)+N$(7)+"BM18,38"+N$(8)+N$(9)
1320 DRAW"BM38,38;D6BR4U6R4D6L4BR8U6BR4D6"
1330 DRAW"BM18,54;U6BR2R4D3L4D3R4BR4U6BR2R4D3NL4D3L4BR
8U6BR2D4R2NU2ND2R2BR4D2U6BR2NR4D3R4D3L4"
1340 DRAW"BM124,20;S16"+N$(1)+N$(2)+N$(3)
1350 DRAW"BM86,60;"+N$(4)+N$(5)+N$(6)+N$(7)+"BM86,100;
"+N$(8)+N$(9)
1360 DRAW"BM164,102;D6BR3U6R4D6L4BR8U6BR4D6"
1370 DRAW"BM84,166;U6BR3R4D3L4D3R4BR3U6BR3R4D3NL4D3L4B
R7U6BR3D4R2NU2ND2R2BR3U4D6BR3R4U3L4U3R4"
1380 DRAW"S4;C4"
1390 GOTO 1610
1400 REM DRAW HUMPTY
1410 PMODE3,1:PCLS2
1420 LINE(80,16)-(240,176),PSET,B
1430 LINE(80,125)-(240,125),PSET
1440 CIRCLE(160,96),50,4,1.3
1450 DRAW"BM125,140;C4;G16H8G8F16E24;BM195,140;F16E8F8
G16H24"
1460 PAINT(85,170),4,4:LINE(110,110)-(210,110),PSET:LI
NE(120,125)-(200,125),PRESET:PAINT(160,125),1,4
1470 PAINT(123,143),1,4:PAINT(197,143),1,4:CIRCLE(140,
70),7,3:PAINT(140,70),3,3:CIRCLE(180,70),7,3:PAINT(180
,70),3,3
1480 CIRCLE(160,85),20,4,0.5,0,0.5
1490 DRAW"BM112,80;G22NF7G5F2NE5F2NE5F2E3D2R2U3E15;BM2
02,74;E20NF7E5F2NG5F2NG5F2G3R2D2L3G22"
1500 PAINT(82,18),3,4:DRAW"BM140,40;C1;U5R5U10R30D10R5
D5L40":PAINT(160,30),1,1
1510 DRAW"BM80,145;C2;R10ND20R10NU20R10ND10R10U14;BM20
0,145;NU14R10ND10R10NU20R10ND20R10;BD20;L20ND15L4BL12L
4ND15L10NU13L10ND15L10NU8L10ND15L10NU8L10ND15L10NU13L1
0ND15L4BL12L4ND15L20;C4"
1520 LINE(16,16)-(56,56),PSET,B
1530 CIRCLE(36,36),12,4,1.3
1540 LINE(16,42)-(26,42),PSET:LINE(46,42)-(56,42),PSET
1550 PAINT(18,54),4,4:LINE(24,38)-(52,38),PSET:PAINT(3
6,40),1,4:PAINT(18,18),3,4
1560 DRAW"BM28,46;C1;G4H4;BM44,46;F4E4"
1570 PSET(33,30,3):PSET(33,31,3):PSET(41,30,3):PSET(41
,31,3)
1580 DRAW"BM33,34;C4;F2R4E2"
1590 DRAW"BM24,35;C2;G5;BM48,35;E5"
1600 DRAW"BM30,24;C1;R2U4R10D4R2L14;C4":PAINT(36,22),1
,1
1610 REM NUMBERS
1620 DRAW"BM98,3;XN$(1);BM137,3;XN$(2);BM177,3;XN$(3);
BM217,3;XN$(4);"
1630 REM SQUARES
1640 FOR I=1 TO 3
1650 LINE(80+40*I,16)-(80+40*I,176),PSET
1660 LINE(80,16+40*I)-(240,16+40*I),PSET
1670 NEXT I
1680 REM LETTERS
1690 L$(1) ="ND8R6D4NL6D4":L$(2) ="ND8R4F2G2NL4F2G2L4"
:L$(3) ="NR6D8R6":L$(4)="R4F2D4G2L4U8"
1700 DRAW"BM70,30;XL$(1); BM70,70;XL$(2); BM70,110;XL$
(3); BM70,150;XL$(4);"
1710 REM ROW,COL.,MOVES
1720 DRAW"BM16,80;ND8R6D4L6R2F4BR4UBR6D8L6BR10BU8D6F2E
2F2E2U6;BM16,100;NR6D8R6BR4R6U8L6D8BR10NU8R6BR4U2;BM16
,140;ND8F4E4DBBR4R6U8L6DBBR10BU8D4F4E4U4BR4NR6D4NR6D4R
6BR4R6U4L6U4R6"
1730 REM?
1740 DRAW"BM56,80;R4D4L2D1BD2D1"
1750 GET(56,80)-(66,88),Q,G
1760 GET(56,60)-(76,68),BQ,G
1770 PUT(56,80)-(76,88),BQ,PSET
1780 REM BLANK PIECE
1790 GET(80,16)-(120,56),B,G
1800 GOTO 330
```

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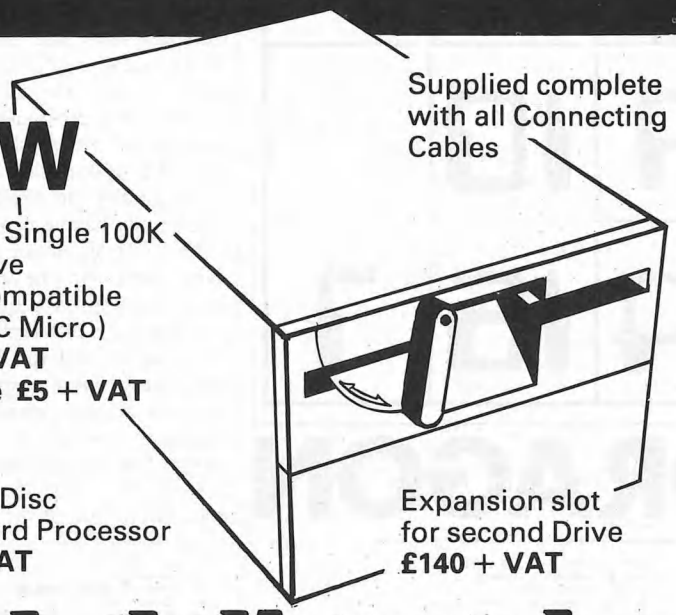

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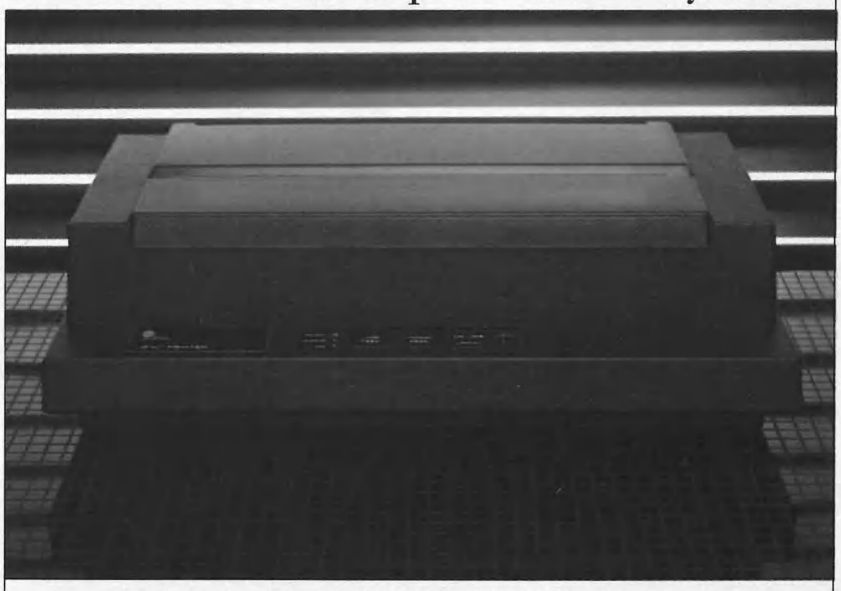

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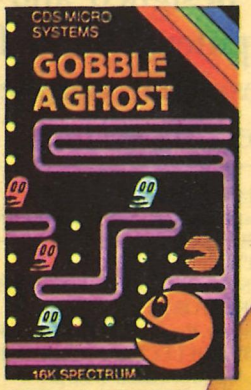

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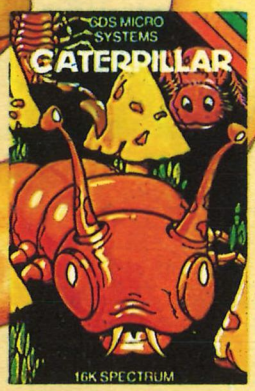

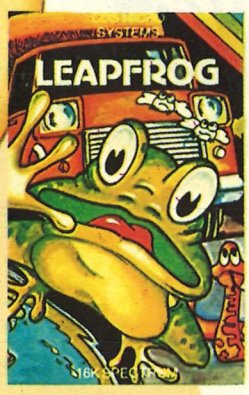

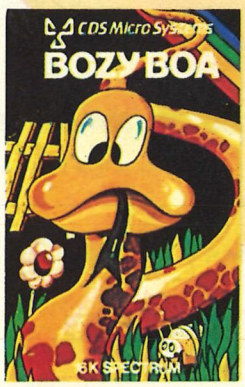

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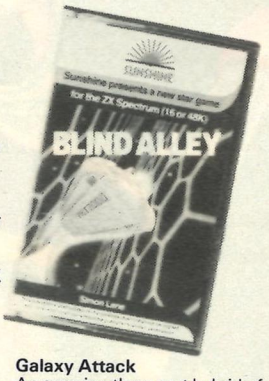

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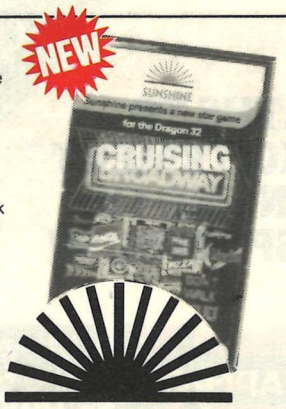

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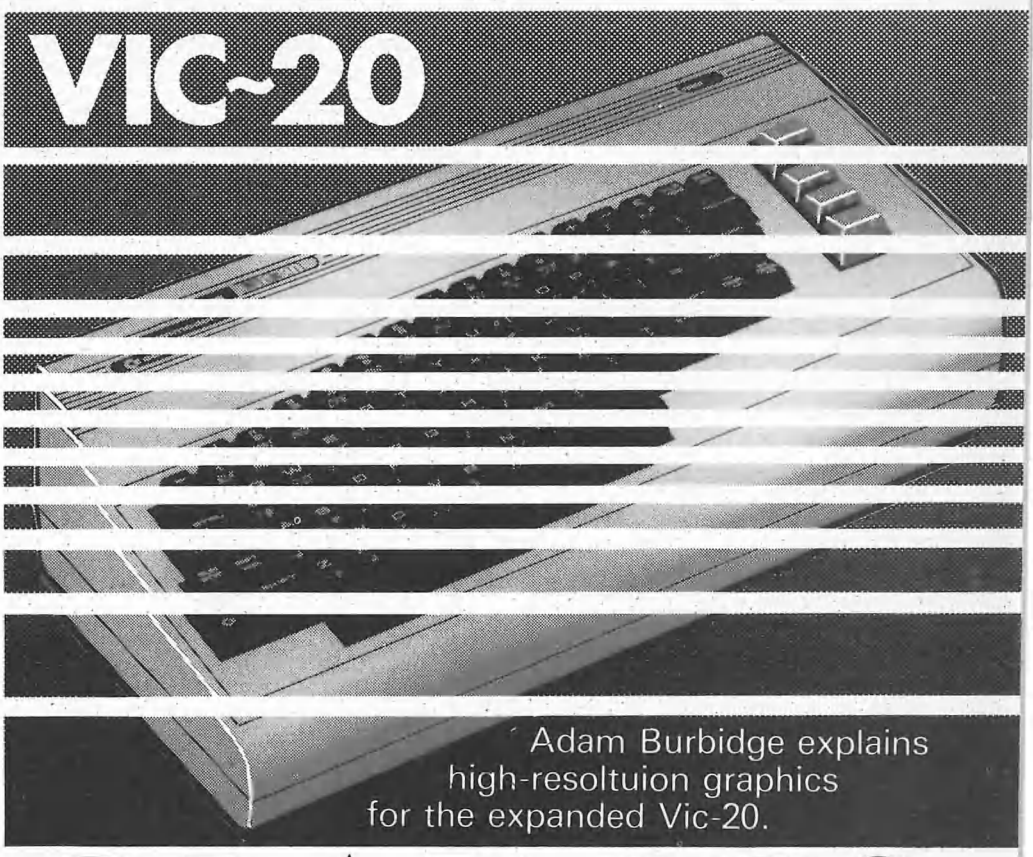

Adam Burbidge explains high-resoltuion graphics for the expanded Vic-20.

GRAPHICS

HIGH-RESOLUTION graphics on the Vic are an obscure subject to many users and nobody seems to be able to use them to any effect. This may be because there is a well-circulated myth that high-resolution plotting is impossible without the super expander cartridge. This is true for those of you with unexpanded Vics, because there is no user-RAM left available after the high-resolution screen is initialised and the plotting routines are installed.

However, if you have a Vic with 8K expansion RAM, it is possible to use high-resolution graphics effectively. At power-up, your Vic displays the message 11,775 Bytes Free, which if you subtract the 3.5K needed for the graphics screen, still leaves you with a nice big lump of something like 8K of free RAM.

The theory behind the use of high-resolution graphics is simple — the practice is not. This is because the whole of the memory map for Basic storage etc., is rearranged.

As all the RAM before 8192, and after 15872 is used for graphics, and routines, the Basic user-space must be reallocated to between these addresses. This can be done by entering this line:

POKE 641,0: POKE 642,32: POKE 643,0: POKE 644,62: SYS 64824

Do not worry, the Vic was supposed to do a cold start. As the more observant of you will have noticed, you have lost 4K of RAM. The power up message should now read:

7679 BYTES FREE

or something near this figure.

What has happened is that the top and bottom of user RAM locations have been changed in order to stop the graphics screen overwriting your Basic program.

For the more technically minded, the high-resolution screen has to be stored at 4096, as this is the only place at which the VIC — Video Interface Chip can access it.

Now that Basic has been relocated you can load the graphics routines which you must have previously saved. Programming in Basic or assembler code can now be carried out in the normal way.

The high-resolution graphics on the Vic work by means of the definable-character facility with the character definitions stored in the address 4096 to 7650, or thereabouts.

However, the Vic only has 256 user-available definable characters and there are 506 screen locations. Therefore, a function called double height characters mode must be used. This sets the character definition grid of 8 by 8 to a double height 8 by 16 matrix. This is done by altering the contents of the VIC chip register at 36867.

Demo 1.

```
 10AC=5
 20POKE 36867,20
 30 POKE 36878,16*AC
 40 POKE 36879,8
 50SYS 16282
 60POKE 864,10:SYS16048
 70POKE 835,4
 80FOR Y=0 TO PI*2 STEP 0.1
 90POKE 833,COS(Y)*60+70
100POKE 832,SIN(Y)*60+70
110SYS 15904
120NEXT
130WAIT 197,192,64
```

Now that double-height characters are installed we can set up the screen as follows:

character numbers

0 10 210
↓ ↓ ↓
9 19 219

But, as the screen starts at 4096 it must also be relocated back to 7680. This is done by a small part of the set-up machine-code routine. The entire character set is set to blanks and the high-resoltuion screen is set up.

To calculate which byte to Poke with the newly plotted point, we need several equations. The byte to be Poked is calculated by:

Byte = 4096 + 16*(INT(X/8)*10 + INT(Y/16)) + ((Y/16)-INT(Y/16))*16

The bit to be changed can be calculated by:

Bit = 7-((X/8)-INT(X/8))*8

When the bit to be changed has been calculated, then a single bit mask will be calculated. This is a binary number with only one bit set, ie:

1 — 00000001
2 — 00000010
4 — 00000100
8 — 00001000
16 — 00010000
32 — 00100000
64 — 01000000
128 — 10000000
Bit No. — 76543210

In order to set a point, the bit mask is logically Ored with the contents of the byte being changed. This is then repoked back into the byte.

In order to reset a point, the bit mask is logically EOred — exclusively Ored — with 255, and then Anded with the contents of the byte.

For example let the contents of the byte to be changed be 10110101. To set bit 3:

```
     10110101
OR   00001000
     --------
     10111101
```

To reset Bit 0:

```
     00000001
EOR  11111111
     --------
     11111110
AND  10110101
     --------
     10110100
```

Multi-colour mode is a state in which the VIC chip will recognise four seperate coloured points. This is, however, impossible with only one bit as we have used up until now, so we have to use pairs of bits. Unfortunately this means sacrificing half of our current resolution.

You can think of multi-colour mode bytes as blocks of four pairs of two bits each, like this:

00 00 00 00

As you can see, we now have four possible types of point:

00, 01, 10, 11

These represent the following colours:

00 — screen colour*
01 — character colour
10 — Border colour*
11 — Auxiliary colour

Asterisk, * indicates that these depend on the contents of 36879.

(continued on next page)

(continued from previous page)

A point set to the screen colour, is invisible, and thus equivalent to a reset point.

The character colour can be set by Poking 864 with the colour required, and called the Clear routine, by typing:

SYS 16048

To use multicolour mode, the colour is Poked as normal, except 8 is added to the value. For example, to clear the screen white:

POKE 864,9:SYS 16048

This is because bit 3 of the character memory byte indicates whether the corresponding screen byte is multi-coloured, or normal.

To use the Basic loader program simply type in the appropriate program and then Save it onto tape or disc. It can then be loaded and run as a normal Basic program after you have typed in the Pokes in figure 1.

This program will destroy itself when run, so Save it before you run it for the first time. Also, as lengthy conversions are carried out, the program takes several minutes to run.

To demonstrate this, set up the routines in memory and type in the program — Demo 1. Run this, and a circle should be drawn in the colour set by the variable AC, on a black background.

There are three visible colours available with which to plot; these are border, characteer, and auxiliary colour. They are set up as follows:

Border colour is set by Poking 36879 with the screen colour. To get cyan border on a red screen we must Poke 36879 with 32+8+3=43. Thus we have eight possible border colours.

Character colour is normally the colour of the print on the screen, but can easily be changed by using the standard clear routine included at 16048. As multi-colour mode is used, we must add 8 to the value of the colour we want. For example, to make the character colour green, Poke 864,13 and SYS 16048 which is the Clear routine.

Auxiliary colour is the most versatile plot colour as it has 16 different variations. To set this, we Poke 36878 with 16* the colour.

For example, to set the auxiliary colour to pink, Poke 36867,160 (10*16).

Colour code	*Colour*
0	black
1	white
2	red
3	cyan
4	purple (magenta)
5	green
6	blue
7	yellow
8	orange
9	pale orange
10	pink
11	pale cyan
12	pale purple
13	pale green
14	pale blue
15	buff

Colour codes

Call address	*Routine*
16282	Setup
16080	Plotcalc
16048	Clear (colour in 864)
16016	Set*
15984	Reset*
15904	Colplot* (colour in 835)

* = x in 832, Y = 833

Figure 1. Loading and running the programs: First, Poke 641,0:Poke 642,32:Poke 643,0:Poke 644,62:sys 64824 then load Basic loader. Next Run and then load "DEMO-1" and Run.

Basic loader program.

```
1 B$="0123456789ABCDEF"
10 FORZ=15904TO16383
20 READA$
30 A1$=LEFT$(A$,1):A2$=RIGHT$(A$,1)
40 FORT=0TO16
50 X$=MID$(B$,T+1,1)
60 IFX$=A1$THENA1=T
70 IFX$=A2$THENA2=T
80 NEXTT
90 POKEZ,A1*16+A2
95 NEXTZ
100 REM DATA
110 DATAAD,40,03,29,FE,8D,40,03,AE,43,03,E0,00,D0,09,20,70,3E,EE,41,03,20,70,3E
,E0,01,D0
120 DATA09,20,70,3E,EE,40,03,20,90,3E,E0,03,D0,09,20,90,3E,EE,40,03,20,70,3E,E0
,04,D0,09
130 DATA20,90,3E,EE,40,03,20,90,3E,60,00,FF,00,FF,00,FF,20,FF,00,FE,00,FF,00,FF
,00,FB,20
140 DATAD0,3E,8E,3C,03,49,FF,2D,3C,03,AE,3E,03,AC,3F,03,8E,88,3E,8C,89,3E,8D,AF
,12,60,00
150 DATA00,00,00,00,20,D0,3E,8E,3C,03,0D,3C,03,AE,3E,03,AC,3F,03,8E,A6,3E,8C,A7
,3E,8D,AF
160 DATA12,60,00,00,00,00,00,00,00,AD,60,03,A2,00,9D,00,96,E8,D0,FA,9D,00,97,E8
,D0,FA,60
170 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,AD,40,03,A0,00,C9,09,10,05,A9
,00,48,90
180 DATA17,38,E9,08,C8,C9,08,B0,F8,EA,8C,3C,03,98,A0,09,6D,3C,03,88,D0,FA,48,EA
,AD,41,03
190 DATAC9,10,30,0A,A0,00,38,C8,E9,10,C9,10,10,F8,68,8D,50,03,98,6D,50,03,8D,50
,03,AD,41
200 DATA03,A0,00,E9,10,C8,C9,10,B0,F9,8D,42,03,A9,10,8D,3F,03,A9,00,8D,3E,03,A0
,00,A2,10
210 DATAAD,3E,03,18,6D,50,03,90,03,EE,3F,03,CA,D0,F4,18,6D,42,03,90,03,EE,3F,03
,8D,3E,03
220 DATAAD,40,03,18,29,07,EA,8D,3D,03,A9,07,38,ED,3D,03,8D,3C,03,EA,AE,3C,03,A9
,01,E0,00
230 DATAF0,05,18,0A,CA,D0,FA,AE,3F,03,8E,79,3F,AE,3E,03,8E,78,3F,AE,AF,12,60,00
,00,00,00
240 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
,00,00,C0
250 DATA20,EC,3F,AD,03,90,09,01,8D,03,90,A9,FC,8D,05,90,A9,00,85,01,A9,10,85,02
,A9,00,A0
260 DATA00,91,01,C8,C0,FF,D0,F9,91,01,A0,00,A6,02,E8,86,02,E0,1E,D0,EC,A9,00,8D
,3C,03,A2
270 DATA00,A0,00,9D,00,1E,18,69,0A,C8,E8,C0,16,D0,F4,EE,3C,03,AD,3C,03,A0,00,E0
,DC,D0,E8
280 DATA60,AD,02,90,09,80,8D,02,90,A9,1E,8D,88,02,A5,93,20,D2,FF,60,02
```

The purpose of Setup is to set up the high-resolution screen ready for plotting. There are no parameters. Call address: 16282.

This will clear the screen, and set up high-resolution mode. Several lines of jibberish will remain at the bottom of the screen — these may be removed by typing:

POKE 36867,20

The purpose of Plotcalc is to calculate the part of memory, and a single bit mask, in which a point occurs. Parameters: X position is in 832 and Y position is in 833. Call Address: 16080.

If this routine is called on its own, then nothing will seem to occur. This is because Plotcalc only sets up the address and bit mask for other routines. However, it is useful in itself, as it consists of four seperate parts: Charcalc, Rowcalc, Bytecalc and Bitcalc. These routines use parts of memory for variable storage, as follows:

Location	Name	Function
848	Char	Stores the character number within which the current point falls.
834	Row	The current row in the character in which the point lies
830-831		LSB and MSB respectively of the byte which was calculated as the one in which the current point lies.

With some cunning programming, it could easily be rigged so that the character colour — or normal colour if plotting is not in multi-colour mode — is selectively set for each point plotted. The big snag with this is that any other points within the boundary of the character colour changed will also change colour. Therefore only one character colour is possible per group of 16 by 8 points — the double-height character size.

The purpose of Clear is to set the screen character colours to a specified choice. The character colour is in 864. Call Address: 16048.

This does not affect the contents of the actual high-resolution screen so this routine can be called during a display without ruining the picture on the screen.

The purpose of Set is to set a high-resolution point — not multi-colour. Parameters: X is in 832 and Y is in 833. Call Address: 16016.

This routine will call Plotcalc and then set the point calculated from this address.

Reset's purpose is to clear a high-resolution point — not multi-colour. Parameters: X is in 832 and Y is in 833. Call Address: 15984.

This routine also calls Plotcalc and then resets the point calculated from this address.

Colplot sets a multi-colour mode-point. Parameters: X is in 832 and Y is in 833. Colour is in 834. Call Address:15904.

The set and reset routines are called, according to the colour of point to be set, as detailed in the theory section.

When using graphics, the following procedure must always be observed:

- Call the Set-up routine.
- Set the character colour with the Clear routine.
- Set the screen and border colour, by Poking 36879.
- Set the auxiliary colour by Poking 36878.

Plotting can then be done as normal. ■

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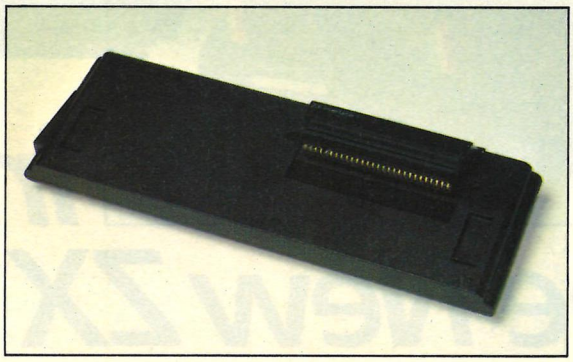

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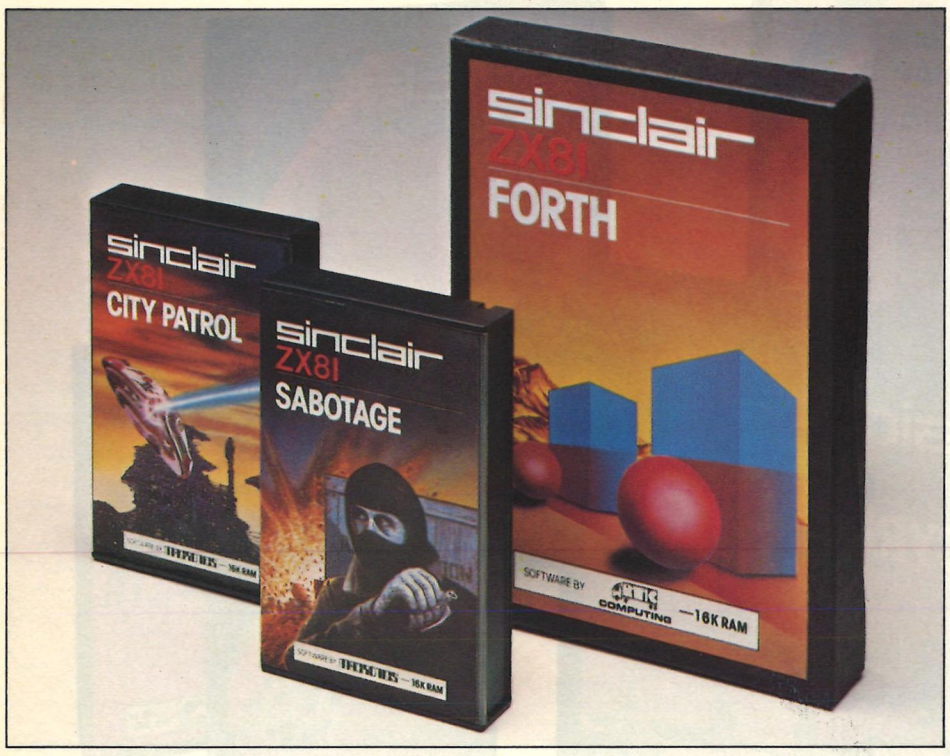

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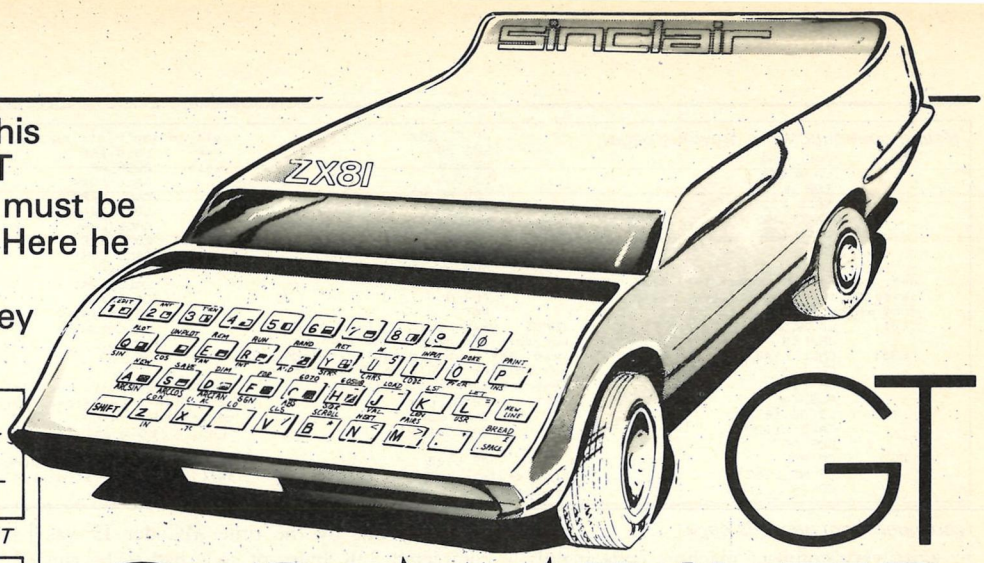
ZXGT COMPILER

David Threlfall continues his insight into how the ZXGT compiler works and what must be considered in the design. Here he looks at the compiler's shortcomings and how they have been overcome.



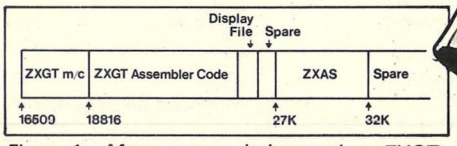


Figure 1a: Memory map during work on ZXGT

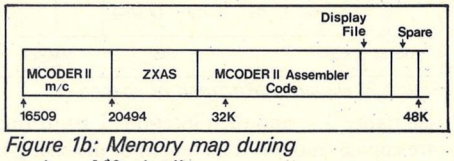


Figure 1b: Memory map during work on MCoder II

A FEW MONTHS after ZXGT had been put on the market as MCoder a few of its shortcomings became apparent. As it stood it worked extremely well, was very fast and far exceeded its original specification, but there are several areas where improvements would be welcome. Problem areas include;

■ No strings — this can be circumvented but string handling would make more a much more versatile compiler.

■ Only 25 variables — programs written for ZXGT were getting larger and this restriction was proving a major handicap to writing understandable code. Multi-character names were necessary, not even two-character names as on the Pet could be considered.

■ Only one numeric array — the array was added as an afterthought primarily to help fulfil the role of data logger on scientific experiments. A full 26 arrays, even if one dimensional, would be very useful.

■ Printing was not *à la* Basic — each number was printed with a leading space and "," did not tabulate.

■ Lprint was not supported.

■ No Boolean algebra at all — a little would be useful.

■ Input was totally non-standard, it appears on the main screen not on the input area and there is no rubout. Input at the bottom of the screen with the ability to correct mistakes was necessary.

■ At about 56 times faster than Basic it was not slow but work on the Spectrum version had shown that more speed was possible — the final version is almost 70 times faster than Basic.

■ Brackets are necessary except in Let — this is compatible with Basic but annoying.

■ Last but still relevant was size. The original ZXGT had been aimed at 2K bytes and only just ran over but most users gave the impression that to obtain the items above they would sacrifice a little more space and longer loading time. 4K was felt to be optimum if all these features could be added.

■ Floating point. Slight consideration was given to full floating-point arithmetic. However, work with Microsoft's compiler on a larger machine had shown that a speed up of only five or so could be expected particularly as Sinclair's ROM routines are very slow. Put another way the balance between interpretation and evaluation is heavily on evaluating. For this reason primarily it was decided to stay with integer arithmetic on all the compilers for Sinclair computers.

Readers may wonder why these features were not implemented in ZXGT. ZXGT was not written directly in machine code but in assembler, a listing of which has been appearing in parallel with this text. It is hard

(continued on next page)

```
The Sinclair functions are
examined here and code
appropriate to each is
generated.
PEEK ?
 L16:    CP 211
         JR NZ,L161
         CALL L108
         LD HL,#6F7E
         CALL L36
         LD HL,#0026
         JP L36
USR ?
 L161:   CP 212
         JR NZ,L162
         CALL L108
         LD HL,L163
         JP L39
 L163:   LD BC,L160
         PUSH BC
         PUSH HL
         RET
 L160:   LD H.B
         LD L.C
         RET
CODE INKEY$ ?
 L162:   CP 196
         JP NZ,L168
         CALL L240
         CP 65
         JP NZ,L252
         LD HL,L53
         CALL L39
         LD A,38
         LD HL,#6F00
         JP L38
RND ?
 L168:   CP 64
         JP NZ,L172
         LD HL,L117
         JP L39
ABS ?
 L172:   CP 210
         JR NZ,L201
         CALL L108
         LD HL,#7CCB
         CALL L36
         LD A,196
         LD HL,L231
         JP L38
```

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```
INT ?
 L201:   CP 207
         JP NZ,L252
         JP L108
 L244:   CALL L108
Get a pair of arguments and
generate the code
    ld hl,nnnn or ld hl,(nnnn)
    push hl
    ld hl,nnnn or ld hl,(nnnn)
    pop de
         CALL L240
 L246:   PUSH AF
         LD A,229
         CALL L241
         CALL L108
         LD A,209
         CALL L241
         POP AF
         RET
Work out what the next thing is.
Is it a variable, a number or a
function?
 L108:   CALL L240
 L102:   CP 22
         PUSH AF
         CALL Z,L240
         CP 16
         JR Z,L218
         CP 64
         JR NC,L97
         CP 38
         CALL NC,L245
         CALL C,L86
 L98:    POP AF
         CALL Z,L230
         RET
 L97:    CALL L16
         JR L98
 L218:   CALL L200
         JR L98
Generate negation code.
 L230:   LD HL,L231
         JR L39
Actually do the negation.
 L231:   LD A,H
         CPL
         LD H,A
         LD A,L
         CPL
         LD L,A
         INC HL
         RET
```

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```
Get variable then code is
generated for ld hl,(nnnn).
 L245:   CALL L37
         CP 100
         JP Z,L234
         LD A,42
         JP L38
Get integer then code generated
for ld hl,nnnn.
 L86:    CALL L81
         LD A,33
         JR L38
STOP statement seen
 L110:   CALL L96
         POP HL
         LD BC,(16507)
         RET
CLS statement seen. Generate a
call to the ROM.
 L52:    LD HL,#A2A
         JR L39
SCROLL statement seen. Generate
a call to the scroll routine.
 L130:   LD HL,L131
         JR L39
A routine to save either HL as
code, HL and A as code or to
generate a call to the number
presently in HL.
 L39:    LD A,205
 L38:    CALL L241
 L36:    LD A,L
         CALL L241
         LD A,H
         JP L241
POKE , get the two arguments and
make sure that a comma separates
them.
 L141:   CALL L244
         CALL L107
         LD HL,#73EB
         JR L36
Check that the char in A is a
comma, if not error.
 L107:   CP 26
         JP NZ,L252
         RET
```

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```
FOR statement seen. Generate
code to load the variable with
the first number and keep the
second number incremented by one
in the next location.
 L100:   CALL L240
         CALL L37
         PUSH HL
         PUSH HL
         CALL L240
         CALL L244
         LD A,35
         CALL L241
         LD HL,#53ED
         CALL L36
         POP HL
         CALL L36
         LD A,34
         INC HL
         INC HL
         CALL L38
         POP HL
         LD DE,(16507)
         CALL L170
         RET
NEXT statement. Find the
variable name and generate code
to increment it and test if we
have reached the end. See Text.
 L101:   CALL L240
         CALL L37
         PUSH HL
         PUSH HL
         LD A,42
         CALL L38
         LD HL,#2223
         CALL L36
         POP HL
         CALL L36
         INC HL
         INC HL
         LD A,237
         CALL L241
         LD A,91
         CALL L38
         LD A,167
         LD HL,#52ED
```

(listing continued on next page)

(listing continued from previous page)

```
        CALL L38
        LD A,250
        POP HL
        CALL L171
        EX DE,HL
        CALL L38
        RET
                                        13
Get a number from the code
skipping over the floating point
form which follows it.
 L81:   LD HL,0
        JR L83
 L85:   CALL L240
        CP 126
        JR Z,L84
        PUSH AF
        LD DE,10
        CALL L112
        POP AF
 L83:   CP 38
        JP NC,L252
        CP 28
        JP C,L252
        SUB 28
        LD B,0
        LD C,A
        ADD HL,BC
        JR L85
 L84:   PUSH HL
        LD HL,(16406)
        LD DE,5
        ADD HL,DE
        LD (16406),HL
        POP HL
        RET
INPUT   statement.   Find   the
variable and generate a call to
read  the keyboard and then code
to  put the result in  the  slot
reserved for that variable.
 L75:   LD HL,L80
        CALL L39
        CALL L240
        CALL L37
        JP L105
PLOT statement. Find the pair of
arguments  and  then generate  a
call to the Plotting routine.
 L60:   LD A,#9B
 L61:   PUSH AF
        CALL L244
        CALL L107
        LD HL,#454B
        CALL L36
        LD A,#3E
        CALL L241
        POP AF
        CALL L241
        LD A,#32
        LD HL,#4030
        CALL L38
        LD HL,L113
        JP L39
                                        14
UNPLOT statement. Much like PLOT
but  with a  different  argument
generated.
 L65:   LD A,#A0
        JR L61
RAND statement.  Gets number and
puts it into location 16436.
 L31:   LD A,42
        LD HL,16436
        CALL L38
        LD A,34
        LD HL,16434
        JP L38
IF tests start here. Arrive with
DE=first argument, HL=second and
A=operation. Result is carry set
if condition true.
 L180:  CP 221
        JR Z,L182
        CP 20
        JR Z,L184
        RRA
        JR NC,L181
        EX DE,HL
 L181:  RLA
        AND A
        SBC HL,DE
        SCF
        RET M
        RLA
        RET NC
```

(listing continued on page 123)

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to write very compact machine code mainly because changes and corrections are nearly impossible so space is always left just in case.

However, it is impossible to fit an assembler, the target code and the source for more than 1.5K of machine code in a 16K machine. That is why the code was written in two longish sections — figure 1a. This left two options — write the code in more than two sections — two were hard to manipulate, three or more would be devilish — or bootstrap from Basic.

The concept of bootstrapping is to write a small compiler with features that allow you to write a larger one. At least one Algol compiler has been written that way. Just a kernel of machine code is necessary to get started and this already existed in ZXGT.

This route was avoided since the code generated by ZXGT is 16-bit integer and therefore would not be suited to the mainly eight-bit character handling of a compiler. Perhaps somone would like to write an eight-bit version of ZXGT — it would be even faster.

Now, you are probably asking why I did not buy a 32K or larger memory pack. The answer is that I had one but that ZXAS — the assembler I had — sat in the 27 to 32K slot so stopping Basic from crossing the 32K word boundary. For those who do not already know, it is quite permissible for Basic code — not just variables and arrays — to cross this boundary but at no time must the display file straddle the line, either side is equally alright. Also, you cannot run machine code which sits above 32K.

Salvation finally came when DCoder arrived on the market. DCoder is a disassembler but more important it is a relocator so it was possible to relocate ZXAS to sit above the compiler machine code — figure 1b.

Relocatable code is code which may be put and run anywhere in the machine. It is easy to write relocatable sub-routines but whole programs are harder. Suffice to say that neither ZXAS or ZXGT are relocatable.

So a relocator is a smart disassembler which can spot which jumps and calls are to within the code to be moved and change them appropriate to the new location. This does not make the relocated code relocatable but merely changes where it will run. The twist to this story is that DCoder was written independently by someone using MCoder — alias ZXGT.

The third major limitation was the Sinclair tape interface. I have rarely had any trouble with this but by the time MCoder II was completed 32K bytes of code had to be run back in each time the machine crashed. With the standard tape interface that takes about 15 minutes. This time the remedy was QSave which records 32K bytes in a little under one minute onto a standard tape recorder.

The final piece in the jigsaw, which arrived when MCoder II was nearly complete, was Ian Logan's ROM disassembly for the ZX-81. This allowed several new features to be added by using ROM routines to save space. ROM routines were only used where time was not critical eg. in Lprint. It also explained some of the clever but slow features of Sinclair's Basic.

In this section problem areas will be discussed in detail.

■ Strings: The major difficulty with strings was to avoid garbage collection when the string was lengthened or shortened. Eventually this was solved by decreeing that all strings would have a maximum length of 32 bytes. This length is held in a location that is known to the user so that it may be Poked from Basic.

The value is reset to 32 when the compiled program is run and must be Poked from your program. By this means the maximum length for individual strings can be set as the string is used for the first time. Thereafter the length of that string cannot be increased beyond that limit. There are no string arrays.

All strings — and numeric arrays for that matter — are allocated space at run-time and so sizes need not be preset. These strings/arrays are stored above Stkend. Consider this short program:

```
1 INPUT N
2 DIM A(N)
3 LET B$="QWERTYUIOP"
4 LET C$="BROWN FOX"
5 DIM X(N+N)
```

The program would prompt for N, allocate the array A — 2*N bytes to be zeroed — allocate B$ and C$ and finally allocate the array X of length 2N. Note the use of addition rather than multiplication to form 2N. Multiplication takes 10 times longer than addition and division 50 times longer. The result is the memory map shown in figure 2.

To concatenate strings, and that includes CHR$, INKEY$ or "string", it is necessary to form the new string elsewhere than its final resting place in case a string appears both on the left and right hand side of the assignment. For example:

```
LET A$ = A$(1 TO 3) + A$(6) + CHR$
128 + B$ + "*"
```

results in the new A$ being built above Last —

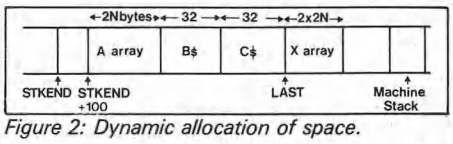

Figure 2: Dynamic allocation of space.

see figure 3 — and then locations Last to End are copied into A$. The length of the string is simply the number of bytes between Last and End.

Printing strings is a similar process except that the final copy is to the screen. A more difficult task is to compare two strings, for example:

```
IF A$ <> B$ THEN PRINT "NOT EQUAL"
```

A copy of A$ is made above Last — which is reset first — and a copy of B$ is made above End. Each is terminated with the code 255. With HL pointing to A$ and BC to B$, incrementing and comparing and using the results flags it is possible to do all six standard comparisons with one short routine.

■ Full variable names: Sinclair Basic is rare in allowing variable names of any length which may contain spaces if desired. Apart from disallowing spaces this is fully implemented in MCoder II. The variable names are stored as shown in figure 4. The names are entered downwards from just below the machine stack — actually 256 bytes clear of RAMtop — and the last letter is stored in inverse video, ie., bit seven is set.

For strings the names are considered to be A$ to Z$ and for arrays A< to Z< thereby differentiating between the three sorts of variable. An example might be to store the names Fred, A$, One and an array C, these would be stored down from just below the stack thus:

```
F
R
E
Inverse D
A
Inverse $
O
N
Inverse E
C
Inverse <
0
```

The zero on the bottom marks the end of the list. There can only be 255 variables as a single byte is used to store the number of variables. A careful note should be kept during compilation of the maximum number of concurrent variables together so that space may be reserved for them at the end of the compiled code.

In Basic the command Clear removes all the

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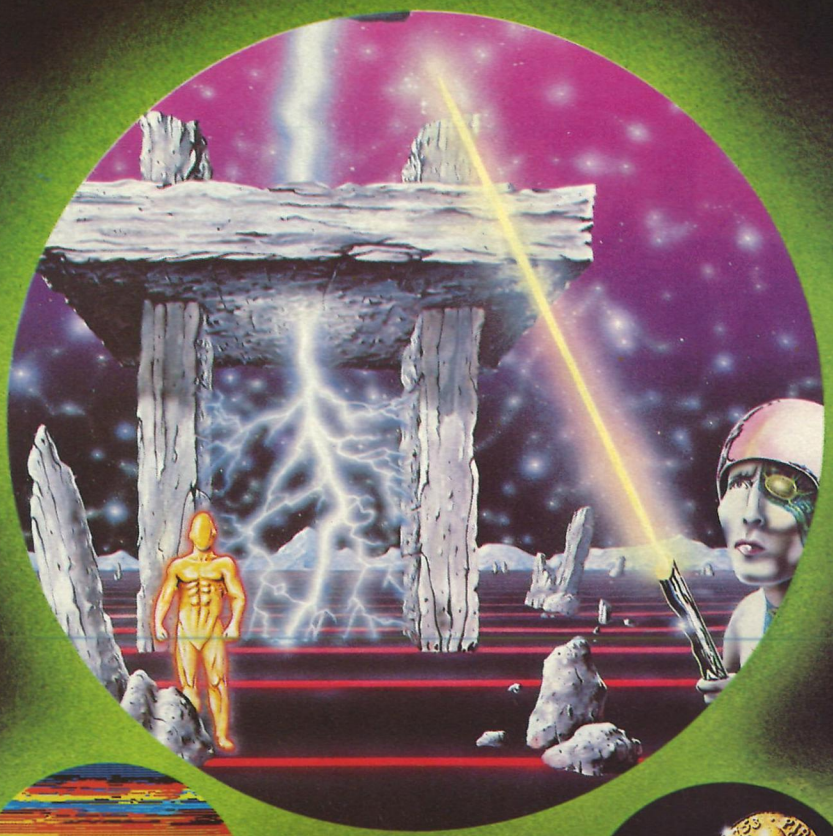

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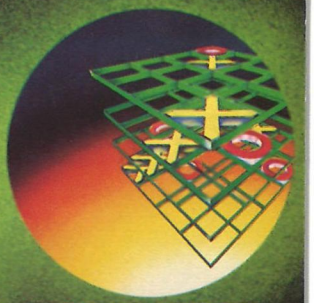

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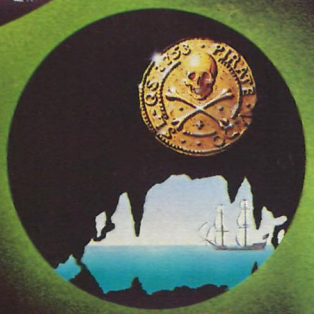

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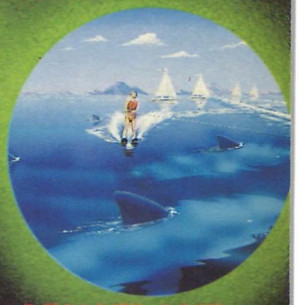

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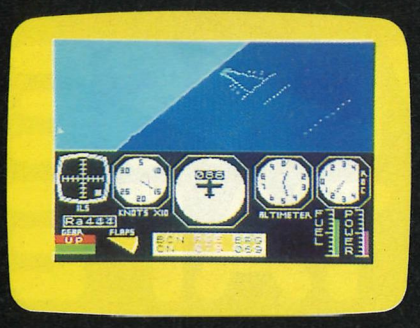
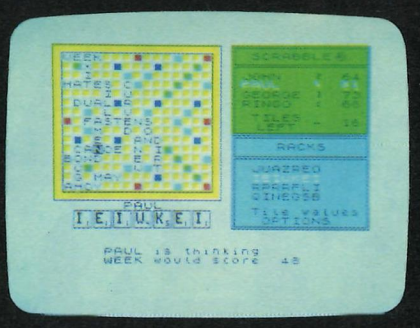


Problem. *Simulating an aircraft on a small microcomputer and depicting the 3-D world outside through the eyes of the pilot.*



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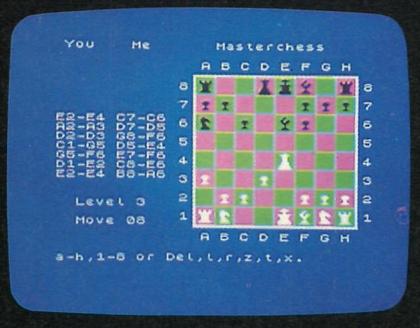
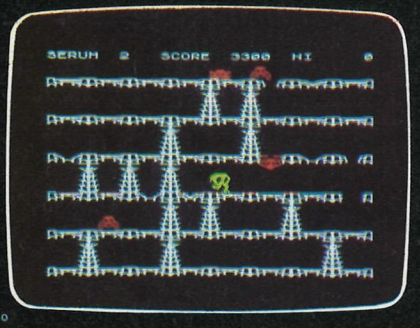
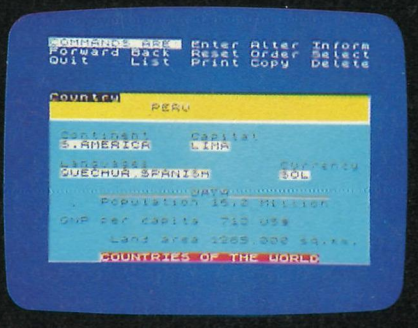


Problem. *Evaluating complex algorithms to provide sufficient depth of analysis in a short time.*

Problem. *Integrating cartoon-quality graphics with the realism of the ski-slope.*



Problem. *Creating cartoon-quality graphics in an entertaining and varied game.*



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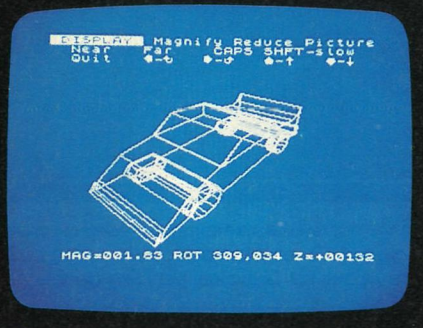
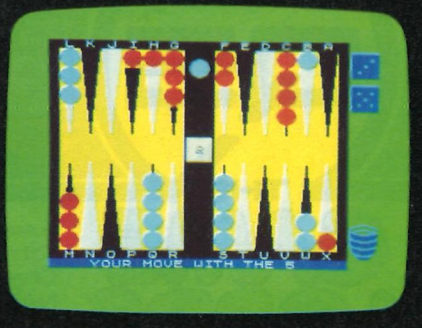


Problem. *Modelling in 3-D on a small micro – performing some 7.5 million calculations for one hidden line drawing.*



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(continued from page 120)

variables, but in MCoder the command merely zeroes all the variables used in the program. Zeroing the locations reserved for a string variable actually zeroes the pointer to the string implying that it has not yet been allocated.

■ Numeric arrays: As the DIM statement for an array is encountered by the compiler, code is generated to load the HL register pair with the length of the array — always one dimensional — and a call is generated to the "allocate space and zero" routine. This generates and stores a pointer to where the array is to be put and then zeroes the array as follows:

```
LD HL, where array is to be put (=LAST)
LD, BC, length of array*2
LD D, H
LD E,L
INC DE
LD (HL),0
LDIR
LD (LAST),DE
```

If the array already exists then the old one is forgotten and a new one created. This failure to collect old, unused space can be wasteful but is not considered too detrimental.

Array elements are accessed by calculating the index, doubling it — two bytes per element — and adding this number to the base address of the array. No array bound checking is done as the code is assumed to be fully tested under Basic.

■ Printing to the screen: To attain the same result as Basic is really only a matter of attention to detail. However, the Tab command may be of some interest. Sinclair stores the column number where printing is to take place next but stores it backwards. The actual column number stored is 33 — the number the user inputs. For example Tab 5 makes the system variable S_POSN (16441) take the value 28 and Tab 25 yields the value 8.

■ Printing to the ZX printer: If printing to the screen is clear, but perverse, consider Lprint. The printer buffer is in locations 16444 to 16476. Tab 5 makes PR_CC take the value 69 and Tab 25 makes it 89, these numbers being the lower byte of the address in the buffer. Otherwise the change from Print to Lprint commands requires only that bit one of location 16385 be set and then Sinclair's routines for Print, Tab, At etc may be used.

■ Boolean operations: Only two Boolean operations have been made available in MCoder II:

B AND C which is true if B and C are non zero
B OR C which is true if either B or C or both are non zero.

These are only implemented in the If statement using routines for Or and And which are called with HL containing one 16 bit argument and DE the other. They return a set carry flag if the result is true.

```
AND:  LD A,H     ;test if
      OR L       ;HL is zero
      RET Z      ;return if it is

      LD A,D     ;now do DE
      OR E
      RET Z
      SCF        ;set carry flag
      RET        ;return
OR:   LD A,H     ;test if HL zero
      OR L
      JR Z,+2    ;jump on if it is
      SCF        ;HL non zero, set carry
      RET
      LD A,D
      OR E
      RET Z      ;both HL and DE zero
      SCF
      RET
```

■ Input: This had to be completely rewritten to be like Basic. For simplicity of coding input is limited to 31 characters plus the prompt so that it all fits on one line. This avoids the problem of compressing the display file. Invalid characters will not print, incorrect ones may be rubbed out, but you cannot step over characters using the cursors.

The screen is used as the input buffer and a string input is copied directly to the space reserved for the variable. The length can be ascertained from the position of the cursor. At the end the buffer is cleared using part of the array zeroing routine described above.

■ Speed: In ZXGT the particular If test to be carried out was decided at run-time. This resulted in very short code for the six functions. In MCoder II code is generated at compile time. As before HL and DE contain the two operands in the general form.

IF operand1 operator operand2 THEN

and the code generated is:

```
LD HL,operand1   ;this may be the result of an
                  evaluation
PUSH HL
LD HL,operand2
POP DE
AND A            ;clear carry flag
SBC, HL, DE      ;subtract the two operands
                  from each other
JP 'flag', NEXT
.........        ;code to be executed if the
                  condition
.........        ;is true
NEXT: .........  ;next statement after IF
```

where 'flag' depends on the operator. For example <> requires the use of the zero flag. This results in considerably quicker code than in ZXGT, often by almost 50 per cent.

■ Brackets: Originally an arithmetic expression was terminated either by the end of line character — 118 — or by a right bracket. The change required to evaluate an expression where brackets are not necessary — ie, like Basic — turned out to be very easy but needed the logic to be stood on its head. The expression is now not terminated by the four operators +,—,/,* and everything else means that the end has been reached, be it with a comma, semicolon, bracket etc.

Sinclair makes a distinction between the way that various functions decide where their arguments stop. For instance Peek 16388+1 means (Peek 16388)+1 not Peek (16388+1) but Poke 16388+1,n means the same as Poke 16389,n.

It seemed as if all the functions just picked up the next item, enclosed in brackets if necessary, while statements such as Poke, Plot etc., took expressions treating the comma or end of line as terminator. However, all was not so simple as Tab, which seems to be a function, takes the whole expression up to the next delimiter eg., Tab 5+3 means Tab 8.

■ Size: The final size of MCoder II at 3980 bytes is considerably larger than ZXGT/MCoder showing how expensive in space the refinements proved but it is a much easier program to use and its versatility is greatly enhanced.

I hope that this short series has given some insights into the way that a compiler works and what it is necessary to consider in the design.

ZXGT is marketed by Personal Software Services, 452 Stoney Stanton Road, Coventry CV6 5DG. ■

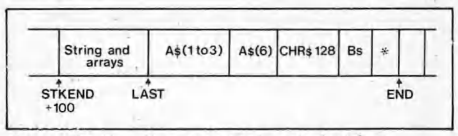


Figure 3: Forming a concatenated string.

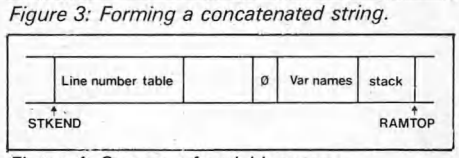


Figure 4: Storage of variable names.

(listing continued from page 120)

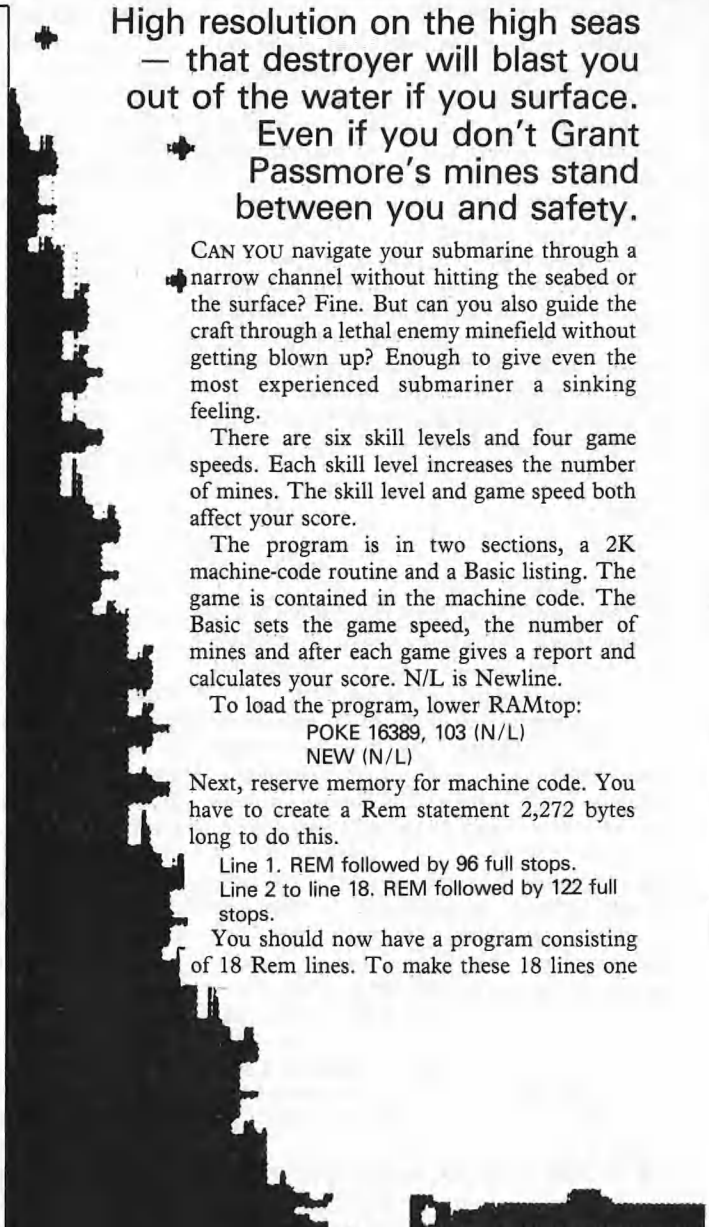
```
        JR L188
L182:   SBC HL,DE
L183:   SCF
        RET NZ
        JR L185
L184:   SBC HL,DE
L188:   SCF
        RET Z
L185:   CCF
        RET
IF statement. Generate code to
get the two operands to be
compared and put operation in A
register. Generate call to " If
tests". On return test carry and
jump to next line of code if its
not set.
L186:   CALL L244
        LD H,A
        LD L,62
        CALL L36
        LD HL,L188
        CALL L39
        LD HL,(16394)
        INC HL
        CALL L91
        EX DE,HL
        CALL L171
        EX DE,HL
        LD A,218
        CALL L38
        CALL L240
        CP 222
        JP NZ,L252
        RET
FAST and SLOW statements.
Because the direct calls to the
ROM moved in the new ROM some of
the ROM code is duplicated here.
L40:    LD HL,L103
        JP L39
L103:   CALL #02E7
        LD HL,#403B
        RES 6,(HL)
        RET
L30:    LD HL,L104
        JP L39
L104:   LD HL,#403B
        SET 6,(HL)
        JP #207
Get address of next line. Enter
with HL pointing to the length
of the present line. Return with
HL pointing to the new line.
L50:    LD C,(HL)
        INC HL
        LD B,(HL)
        ADD HL,BC
        INC HL
        LD A,(16396)
        SBC A,L
        RET NZ
        LD A,(16397)
        SBC A,H
        RET
DIM statement. Make sure
argument is only single
dimensional. The size is ignored
as there is only one array. Note
that the array is not zeroed.
L236:   CALL L240
        CP 63
        JP NZ,L252
        CALL L108
        XOR A
        RET
                                16
These last two routines are used
in calculating the location of
an array element. Basically the
subscript is doubled and added
to the contents of STKEND
(16412).
L233:   CALL L108
        LD HL,#4BED
        CALL L36
        LD HL,16412
        CALL L36
        LD HL,#929
        JP L36
L234:   CALL L233
        LD A,#D5
        CALL L241
        LD HL,L171
        CALL L39
        LD HL,#D1EB
        JP L36
Finally a jump list which links
to the jump list at the start of
the first section. Although
relatively expensive in space
this method is pretty fool proof
if any code is moved.
L151:   JP #408B;PRNT
L131:   JP #408B;SCROLL
L51:    JP #408E;GETK
L53:    JP #4091;TESTK
L111:   JP #4094;PAUSE
L112:   JP #4097;MULT
L113:   JP #409A;PLOT
L114:   JP #409D;RST10
L115:   JP #40A0;#B6B
L116:   EX DE,HL
        JP #40A3;DIV
L117:   JP #40A6;RND
L80:    JP #40A9;GETNUM
L187:   JP #40AC;REM
L241:   JP #40AF;SAVE
```

Program 1. The Basic listing.

```
   4■SAVE "SEA MINE■"
   5 RAND
   6 CLS
   8 PRINT AT 0,0;"
```

mines SEA

```
                    G.S.P. COM
PUTER   SOFTWARE"
  10 LET SC=0
  12 LET TSC=0
  15 LET S$="000000"
  18 LET R$=5$
  20 LET SU=5
  40 PRINT AT 8,3;"SELECT INITIA
L SKILL LEVEL";C$;C$;TAB 7;"1. L
IEUTENANT";TAB 7;"2. LIEUT. COMM
ANDER";TAB 7;"3. COMMANDER";TAB
7;"4. CAPTAIN";TAB 7;"5. COMMODO
RE";TAB 7;"6. ADMIRAL";C$;C$;TAB
 10;"PRESS KEY 1 TO 6"
  60 LET K$=INKEY$
  61 PRINT AT 19,20;"■ TO ■"
  62 FOR F=1 TO 3
  63 NEXT F
  64 PRINT AT 19,20;"1 TO 6"
  65 IF K$="" THEN GOTO 60
  70 IF CODE K$<29 OR CODE K$>34
 THEN GOTO 60
  72 GOSUB 1000
  75 LET A=CODE K$-28
  80 PRINT AT 8,3;"SELECT GAME S
PEED.";C$;C$;TAB 7;"1. VERY FAST
";TAB 7;"2. FAST";TAB 7;"3. AVER
AGE";TAB 7;"4. SLOW";C$;C$;C$;C$
;TAB 10;"PRESS KEY 1 TO 4"
  81 IF INKEY$<>"" THEN GOTO 81
  82 LET K$=INKEY$
  83 PRINT AT 19,20;"■ TO ■"
  84 FOR F=1 TO 3
  85 NEXT F
  87 PRINT AT 19,20;"1 TO 4"
  89 IF K$="" THEN GOTO 82
  90 IF CODE K$<29 OR CODE K$>32
 THEN GOTO 82
  95 LET B=CODE K$-28
 100 GOSUB 1000
 105 GOSUB 1500
 109 IF TSC<>0 THEN GOTO 200
 110 IF TSC=0 THEN PRINT AT 10,1
5-(LEN D$/2);D$;C$;C$;C$;TAB 5;"
YOU HAVE 5 SUBMARINES";C$;C$;TAB
 11;"■■■■■■■■■■■■"
 135 GOSUB 2000
 140 GOSUB 1000
 210 POKE 17624,A+2
 215 POKE 16434,(INT (RND*254))+
2
 220 POKE 16910,(B*2)
 230 LET X=USR 16400
 240 IF A*B*RND<3 THEN GOTO 270
 245 POKE 26929,156
 250 POKE 26962,156
 260 POKE 26995,156
 270 LET X=USR 18433
 275 LET ST=PEEK 16417
 280 IF ST=3 THEN GOTO 500
 281 LET A=A+1
 282 IF A=7 THEN GOTO 330
 284 GOSUB 1500
 285 PRINT AT 8,5;"YOU HAVE ESCA
PED FROM";TAB 5;"THE MINEFIELD";
C$;TAB 5;"GAINING PROMOTION TO";
TAB 5;D$;C$;C$;C$
 300 GOTO 340
 330 PRINT AT 8,5;"YOU HAVE ESCA
PED FROM ";TAB 5;"THE MINEFIELD
ADMIRAL";C$;C$;C$;C$;C$;C$;
 337 LET A=A-1
 340 LET FAC=4
 345 GOSUB 4010
 350 PRINT TAB 5;"YOU SCORED : "
 5$;TAB 5;"TOTAL SCORE: ";R$
 351 GOSUB 2120
 353 GOSUB 1000
 355 IF SU=0 THEN GOTO 5000
 360 GOTO 900
 500 LET PO=PEEK 16592+(256*PEEK
 16593)
 505 LET SU=SU-1
 507 IF SU=0 THEN GOTO 5000
 510 LET FA=INT ((PO-26731)/33)
 520 LET FA=FA+2
 530 IF PO<26761 THEN PRINT AT 8
 15-(LEN D$/2);D$;C$;C$;TAB 4;"Y
OU BROKE SURFACE.";C$;TAB 4;"THE
 FRIGATE DESTROYED          YOU
R SUBMARINE";C$;C$;
 532 IF PO<26761 THEN LET FAC=3
 535 IF PO<26761 THEN GOTO 650
 539 LET F=156
 540 IF PEEK (PO+31)<>F OR PEEK
(PO+196)<>F OR PEEK (PO+200)<>F
OR PEEK (PO+165)<>F OR PEEK (PO+
66)<>F OR PEEK (PO+166)<>F THEN
GOTO 600
 550 LET FAC=2
 570 PRINT AT 8,15-(LEN D$/2);D$
;C$;C$;TAB 5;"YOU HIT A MINE AT
A";C$;TAB 5;"DEPTH OF ";FA;" FAT
HOMS";C$;C$;
 580 GOSUB 650
 600 PRINT AT 8,15-(LEN D$/2);D$
C$;C$;TAB 5;"YOU HIT THE SEABED
AT";C$;TAB 5;"A DEPTH OF ";FA;"
FATHOMS";C$;C$;
 605 LET FAC=1
 650 GOSUB 4000
 660 PRINT TAB 5;C$;"YOU SCORED
 ";S$;;TAB 5;"TOTAL SCORE: ";R$
;C$;TAB 5;"REMAINING VESSELS : "
;SU
 665 GOSUB 2000
 670 GOSUB 1000
 675 IF SU=0 THEN GOTO 5000
 677 IF B<3 THEN GOTO 900
 680 GOTO 200
 900 PRINT AT 8,5;"PRESENT GAME
SPEED : ";B;C$;C$;TAB 5;"DO YOU
WANT TO CHANGE ";TAB 5;"THE GAME
 SPEED ?";C$;C$;C$;C$;C$;TAB
10;"PRESS KEY YES OR NO"
 910 LET K$=INKEY$
 915 PRINT AT 19,20;"■ES OR ■O"
 916 FOR F=1 TO 2
 917 NEXT F
 919 PRINT AT 19,20;"YES OR NO"
 920 IF K$="" THEN GOTO 910
 925 IF K$<>"N" AND K$<>"Y" THEN
GOTO 910
 930 IF K$="N" THEN GOTO 970
 940 IF INKEY$<>"" THEN GOTO 940
 950 GOSUB 1000
 960 GOTO 80
 970 GOSUB 1000
 980 GOTO 200
 999 STOP
1000 PRINT AT 5,0;C$;C$;C$;C$;C$
;C$;C$;C$;C$;C$;C$;C$;C$;C$;C$;C
$;C$
1010 RETURN
1500 IF A=1 THEN LET D$="LIEUTEN
ANT"
1510 IF A=2 THEN LET D$="LIEUTEN
ANT COMMANDER"
1520 IF A=3 THEN LET D$="COMMAND
ER"
1530 IF A=4 THEN LET D$="CAPTAIN
"
1540 IF A=5 THEN LET D$="COMMODO
RE"
1550 IF A=6 THEN LET D$="ADMIRAL
"
1560 RETURN
2000 GOSUB 2270
2010 IF RND<.5 THEN GOTO 2050
2020 LET K$=T$(1+((RN-1)*24) TO
(RN*24))
2030 LET X=16987
2040 GOTO 2070
2050 LET K$=T$(73+((RN-1)*24) TO
 72+(RN*24))
2060 LET X=17011
2070 GOSUB 2240
2080 LET K$=T$(289+((RN-1)*9) TO
 296+(RN*9))
2090 LET X=17083
2100 GOTO 2290
2120 GOSUB 2270
2130 IF RND<.5 THEN GOTO 2170
2140 LET K$=T$(145+((RN-1)*24) T
O 144+(RN*24))
2150 LET X=17035
2160 GOTO 2190
2170 LET K$=T$(217+((RN-1)*24) T
O 216+(RN*24))
2180 LET X=17059
2190 GOSUB 2240
2200 LET K$=T$(316+((RN-1)*9) TO
 315+(RN*9))
2210 LET X=17092
2220 GOTO 2290
2240 FOR F=1 TO 24
2250 POKE (X+F),CODE K$(F)
2260 NEXT F
2270 LET RN=(INT (RND*3))+1
2280 RETURN
2290 FOR F=1 TO 9
2300 POKE (X+F),CODE K$(F)
2310 NEXT F
2320 RETURN
4000 LET SC=INT (A*(5-B)*(100/FA
)+FAC)*3
4005 IF FAC<>4 THEN GOTO 4012
4010 LET SC=INT (A*(5-B)*FAC)*24
4012 LET TSC=TSC+SC
4015 LET S$=0$(3 TO 6-(LEN (STR$
 SC)))+STR$ SC
4020 LET R$=0$(1 TO 6-(LEN (STR$
 TSC)))+STR$ TSC
4030 RETURN
5000 PRINT AT 7,10;C$;C$;TAB 5;"
ALL SUBMARINES LOST";C$;C$;TAB 5
;"YOU SCORED  ";R$
5001 LET H$=0$(1 TO (6-(LEN STR$
 HSC)))+STR$ HSC
5003 PRINT C$;TAB 5;"HI - SCORE
: ";H$
5004 IF HSC<TSC THEN PRINT C$;C$
;TAB 8;"NEW HI-SCORE.";TAB 11;
"■■■■■■■■■■■■"
5005 IF HSC<TSC THEN LET HSC=TSC
5006 FOR F=1 TO 15
5007 PRINT AT 7,10;"GAME OVER"
5009 FOR A=1 TO 2
5011 NEXT A
5013 PRINT AT 7,10;"■■■■■■■■■■"
5015 NEXT F
5025 PRINT AT 21,4;"PRESS ■■■■■■
■ TO REPLAY"
5026 FOR F=1 TO 2
5027 NEXT F
5029 PRINT AT 21,4;"PRESS NEWLIN
E TO REPLAY"
5030 IF INKEY$<>CHR$ 118 THEN GO
TO 5025
5035 GOSUB 1000
5040 GOTO 8
```



High resolution on the high seas — that destroyer will blast you out of the water if you surface. Even if you don't Grant Passmore's mines stand between you and safety.

CAN YOU navigate your submarine through a narrow channel without hitting the seabed or the surface? Fine. But can you also guide the craft through a lethal enemy minefield without getting blown up? Enough to give even the most experienced submariner a sinking feeling.

There are six skill levels and four game speeds. Each skill level increases the number of mines. The skill level and game speed both affect your score.

The program is in two sections, a 2K machine-code routine and a Basic listing. The game is contained in the machine code. The Basic sets the game speed, the number of mines and after each game gives a report and calculates your score. N/L is Newline.

To load the program, lower RAMtop:

POKE 16389, 103 (N/L)
NEW (N/L)

Next, reserve memory for machine code. You have to create a Rem statement 2,272 bytes long to do this.

Line 1. REM followed by 96 full stops.
Line 2 to line 18. REM followed by 122 full stops.

You should now have a program consisting of 18 Rem lines. To make these 18 lines one

The hexadecimal loader.

```
9000 PRINT "START ADDRESS?"
9010 INPUT X
9015 CLS
9020 LET A$=""
9025 PRINT X;":";
9030 FOR A=1 TO 8
9035 IF A$="" THEN INPUT A$
9040 IF A$="S" THEN STOP
9045 PRINT A$;" ";
9050 POKE X,16*CODE A$+CODE A$(2
)-476
9060 LET A$=A$(3 TO )
9070 LET X=X+1
9080 NEXT A
9090 PRINT
9095 GOTO 9025
9200 PRINT "START ADDRESS?"
9210 INPUT X
9215 CLS
9220 PRINT X;":";
9225 FOR A=1 TO 8
9230 LET A$=
9240 LET A$=PEEK X
9245 LET A$(1)=CHR$ (INT (B/16)+
28)
9250 LET A$(2)=CHR$ (B-(INT (B/1
6)*16)+28)
9260 PRINT A$;" ";
9270 LET X=X+1
9280 NEXT A
9285 PRINT
9290 GOTO 9220
```

Sea Mines hexadecimal dump.

```
16514:3E 1E ED 47 DD 21 51 02
16522:C9 3E 08 ED 47 DD 21 A7
16530:40 C9 21 00 67 0E C0 06
16538:20 36 FF 23 10 FB 36 C9
16546:23 0D 20 F3 C9 21 DF E5
16554:11 21 00 F3 0E FE 06 16
16562:10 FE 06 C0 ED 78 D3 FF
16570:19 CD CF 40 0E C2 B6 40
16578:C8 92 02 CD 30 02 DD 21
16586:A7 40 C3 A4 03 E9 33 73
16594:2A D0 40 11 05 41 1A 77
16602:01 1F 00 09 13 1A 77 23
16610:23 13 1A 77 09 13 0E 04
16618:06 05 1A 77 23 13 10 FA
16626:C5 01 1C 00 09 C1 0D 20
16634:EF 1A 77 23 23 23 23 13
16642:1A 77 09 24 A2 1E 1E 32
16650:1E 1E A2 9B 1E 1E 1E 32
16658:9B 1E 1E 1E 8F 1E 1E 1E
16666:1E 1E 97 20 2A D0 40 11
16674:21 00 09 5D 0E 9E 77 01
16682:1F 00 09 77 0E 05 09 09
16690:77 23 23 77 23 77 CD D2
16698:40 C9 2A D0 40 11 C5 00
16706:19 3E 9E 77 23 77 23 77
16714:11 1F 00 19 77 23 23 23
16722:23 77 CD D2 40 C9 2A D0
16730:40 2B 3E 9E 77 11 1F 00
16738:19 77 23 23 77 19 77 13
16746:13 06 04 19 77 10 FC 29
16754:29 29 29 29 77 CD 40 C9
16762:2A D0 40 23 3E 9E 77 11
16770:1F 00 19 77 23 23 77 11
16778:23 00 19 77 1B 1B 06 04
16786:19 77 10 FC 2B 2B 2B 2B
16794:77 CD D6 40 C9 2A D0 40
16802:11 C1 41 CD D6 40 CD 0C
16810:42 2A D0 40 11 DA 41 CD
16818:D6 40 CD 0C 42 2A D0 40
16826:11 F3 41 CD D6 40 C9 00
16834:0B 92 07 9A 3C 0D 77 04
16842:0D 96 01 1C 01 01 95 95
16850:53 93 38 93 38 01 DB 00
16858:9E 9E 2A 0B 2A 0B 0B 00
16866:2A A5 00 0E 06 0E 8B 0B
16874:2A 99 B8 06 B8 06 B8 0B
16882:2A 9E 9E 9E 9E 9E 9E 9E
16890:9E 9E 9E 9E 9E 9E 9E 9E
16898:9E 9E 9E 9E 9E 9E 9E 9E
16906:9E 9E 00 1E 1B 7A B3
16914:20 FB C9 3A 7B 40 FE 01
16922:20 0A 2A D0 40 2B 22 D0
16930:40 CD 7A 41 FE 03 20 0A
16938:2A D0 40 23 22 D0 40 CD
16946:58 41 3A 7C 40 FE 01 20
16954:0D 2A D0 40 11 21 00 19
16962:22 D0 40 CD 1E 41 FE 02
16970:C0 2A D0 40 11 21 00 C6
16978:00 ED 52 22 D0 40 CD 9C
16986:41 C9 94 36 22 22 2E 2E
16994:0E 22 22 17 17 8B 1E 17
17002:22 22 22 8C 17 17 22 01
17010:1E 17 9E 0B 0B 96 96 96
17018:97 8A 8A 32 32 32 A2 A2
17026:A2 A2 32 A2 A2 A2 8A AA
17034:1E 1E 9E 9E 1D 96 97 97
17042:97 97 0B 9E 1D 96 97 A2
17050:97 97 0B 9E 9E 0B 97 A2
17058:A2 97 9E 9E 99 03 03
17066:22 22 97 9E 9E 9E 2E
17074:9E 9E 2E 9E 2E 22 0E 2E
17082:22 9E 0B 0B 97 19 3B 97
17090:A8 32 33 9E 9E 2E 22 39
17098:8C 17 17 30 0E 22 A2 8B
17106:32 11 0B 06 3E 1E 21 41
17114:7F 0E 04 06 16 77 23 10
17122:FC 19 0C 20 F6 3E 1E 21
17130:6D 68 06 1C 77 23 10 FC
17138:06 90 21 30 6D 11 1F 00
17146:77 19 77 23 23 10 F9 21
17154:61 73 06 60 11 1D 00 77
17162:19 77 23 23 23 23 10 F7
17170:21 92 79 06 30 11 1B 00
17178:77 19 77 11 05 00 19 10
17186:F4 21 AB 7C 06 1B 11 19
17194:00 77 19 77 11 0B 00 19
17202:10 F4 21 38 7E 06 0C 11
17210:17 00 77 19 77 11 0A 00
17218:19 10 F4 21 E8 7A 11 21
17226:00 06 22 77 19 10 FC 21
17234:7E 7D 11 1F 00 06 0E 77
17242:23 23 77 19 10 F9 21 41
17250:7E 06 08 11 19 00 77 23
17258:77 23 77 23 23 23 23 77
17266:23 77 23 77 19 10 EF 18
17274:0E 06 09 1A 77 D5 11 21
17282:00 19 D1 13 10 F5 C9 21
17290:7C 43 3E 18 77 21 18 6A
17298:11 74 42 CD 7B 43 23 11
17306:8C 42 CD 7B 43 11 74 42
17314:CD 7B 43 23 11 8C 42 CD
17322:7B 43 11 74 42 CD 7B 43
17330:23 11 74 42 CD 7B 43 21
17338:37 6A 11 5C 42 CD 7B 43
17346:2B 11 A4 42 CD 7B 43 11
17354:5C 42 CD 7B 43 2B 11 A4
17362:42 CD 7B 43 11 5C 42 CD
17370:7B 43 2B 11 5C 42 CD 7B
17378:43 21 66 7A 11 5C 42 CD
17386:7B 43 21 66 7A 11 74 42
17394:CD 7B 43 21 7C 43 3E 09
17402:77 21 0F 7D 11 BC 42 CD
17410:7B 43 21 18 7E 11 BC 42
17418:CD 7B 43 21 1E 7D 11 BC
17426:42 CD 7B 43 21 29 7E 11
17434:BC 42 CD 7B 43 21 1F 7E
17442:11 C5 42 CD 7B 43 21 1A
17450:7D 11 C5 42 CD 7B 43 21
17458:2D 7E 11 C5 42 CD 7B 43
17466:21 26 7D 11 C5 42 CD 7B
17474:43 C9 61 44 1A 77 13 D5
17482:11 21 00 19 D1 10 F1 C9 21
17490:77 23 13 1A 77 13 D5 11
17498:20 00 19 D1 10 F1 C9 21
17506:DF 7E 11 CE 42 CD 45 44
17514:21 E6 7D 11 CE 42 CD 45
17522:44 21 F0 7E 11 CE 42 CD
17530:45 44 21 DE 7D 11 CE 42
17538:CD 45 44 21 E5 7D 11 CE
17546:42 CD 45 44 C9 CD BB 02
17554:7C FE FF C8 7D FE F7 16
17562:05 FE EF C0 18 0D 7C FE
17570:DF C0 3A 7B 40 3D C8 32
17578:7B 40 C9 7C FE DF 20 09
17586:3A 7C 40 3D C8 32 7C 40
17594:C9 FE EF 20 05 3A 7C 40
17602:3C FE 03 C8 32 7C 40 C9
17610:FE F7 C0 3A 7B 40 3C FE
17618:04 C8 32 7B 40 C9 01 0C
17626:31 69 21 31 69 32 DA 44
17634:3E 0C 32 D9 44 3A DB 44
17642:3D C8 32 D8 44 3A D9 44
17650:3D 28 E7 32 D9 44 2A DA
17658:44 11 21 00 05 03 7E FE
17666:9E 20 11 19 10 F8 2A DA
17674:44 3E 77 77 19 3E 03 77
17682:19 3E 99 77 06 03 CD 3B
17690:45 11 32 00 C6 00 ED 52
17698:16 00 5D 2A DA 44 19 22
17706:DA 44 10 EA 16 5F 9E 2E
17714:E8 45 19 10 F7 23 23 7E
17722:FE 2A 32 40 54 5D 19 29
17730:29 19 19 1B 29 19 22 32
17738:40 C9 29 29 29 16 22 32 40
17746:C9 40 11 29 03 19 7E FE
17754:9E C2 E8 45 19 2B 13 06
17762:06 7E FE 9E C2 E8 45 19
17770:10 F7 C6 00 ED 52 C6 00
17778:ED 52 23 23 05 03 7E FE
17786:9E 52 E8 45 23 10 F7 28
17794:19 7E FE 9E C2 E8 45 C9
17802:3A 7C 40 FE 01 CA C1 45
17810:2A D0 40 11 21 00 C6 00
17818:ED 52 7E FE 9E C2 E8 45
17826:19 28 26 FE FE 9E C2 E8
17834:45 19 23 7E FE 9E C2 E8
17842:45 23 23 06 02 7E FE 9E
17850:C2 E8 45 23 10 F7 C9 2A
17858:D8 40 11 C5 00 19 06 03
17866:7E FE 9E C2 E6 45 23 10
```

SEA MINES

ZX-81

line enter the following direct commands:

```
POKE 16514 ,118 (N/L)
POKE 16515 ,118 (N/L)
POKE 16511 ,226 (N/L)
POKE 16512 ,8 (N/L)
```

Input line 4. Save "Sea Mine (Inv S)".

```
LIST 4 (N/L)
POKE 16419 ,4 (N/L)
```

Then enter the hexadecimal loader routine.

```
GOTO 9000 (N/L)
```

On the prompt enter 16514 then key in the machine-code listing. When you have finished, Save the machine code on tape a couple of times. To test the machine code, add the following lines:

```
10 RAND USR 18400
20 RAND USR 18433
30 STOP
GOTO 10 (N/L)
```

You should now have a picture of a submarine in a deep trench with a frigate waiting on the surface and the seabed climbing steeply up either side of the screen. There should also be a scattering of mines above the submarine.

Press key 6 — the down cursor — and the submarine should slowly move down to the sea bed and be destroyed. The program will then return to Basic with report code 9/30.

If it does not run correctly then lower RAMtop and reload the game from tape. Use the program in the hexadecimal loader routine starting at 9200 to check your machine-code listing against the published listing. Correct any mistakes you find and then rerun the test program. When the machine code has been debugged Save it. Delete all the lines from line 10 onwards.

Variables:

```
CLEAR (N/L)
```

Enter program 2 to assign the characters to T$. Then Run the program and enter the numbers in listing 1.

```
GOTO 10 (N/L)
```

Delete all the lines from line 10 onwards.

Never Run or Clear the computer, use Goto instead of Run.

Finally, enter the Basic listing. To Save the game and make it autostart when loaded do the following:

1. Enter GOTO 1 — do not press N/L yet
2. Start the tape recorder
3. Press N/L

Before you load the game from tape again you will have to lower RAMtop.

```
POKE 16389, 103 (N/L)
NEW (N/L)
LOAD ""
start tape
(N/L)
```

Thanks to Richard Taylor for his high-resolution routine. ■

```
17874:F7 11 1D 00 19 7E FE 9E
17882:C2 E8 45 23 23 23 23 7E
17890:FE 9E C2 C8 47 C9 7E FE
17898:20 06 9E 02 32 8E 44 C9
17906:3E 03 32 8E 44 C9 CD BB
17914:02 7C FE FF C8 7D FE F7
17922:28 05 FE EF C0 18 0D 7C
17930:FD DF C0 3A 7B 40 3D C8
17938:32 7B 40 C9 7C FE DF 20
17946:09 3A 7C 40 3D C8 32 7C
17954:40 C9 FE EF 20 06 3A 7C
17962:40 3C FE 03 C8 32 7C 40
17970:C1 FE F7 C0 3A 7B 40 3C
17978:FE 04 C8 32 7B 40 C9 21
17986:55 7D 22 D0 40 21 02 02
17994:22 7B 40 CD 94 40 03 3A
18002:7B 40 FE 01 CA DA 46 FE
18010:02 CA 6A 47 3A 7C 40 FE
18018:01 CA A2 46 2A D0 40 11
18026:20 00 C6 00 ED 52 7E FE
18034:9E C2 C8 47 1B 06 02 19
18042:7E FE 9E C2 C8 47 23 23
18050:7E FE 9E C2 C8 47 10 EF
18058:23 7E FE 9E C2 C8 47 23
18066:13 13 06 05 7E FE 9E C2
18074:C8 47 19 10 F7 C9 00 00
18082:2A D0 40 11 22 00 19 7E
18090:FE 9E C2 C8 47 19 19 1B
18098:06 05 7E FE 9E C2 C8 47
18106:19 10 F7 11 46 00 C6 00
18114:ED 52 06 03 7E FE 9E C2
18122:C8 47 23 10 F7 11 1E 00
18130:19 7E FE 9E C2 C8 47 C9
18138:3A 7C 40 FE 01 CA 29 47
18146:2A D0 40 11 22 00 C6 00
18154:ED 52 7E FE 9E C2 C8 47
18162:11 FF 00 06 02 19 7E FE
18170:9E C2 C8 47 23 23 7E FE
18178:9E C2 C8 47 10 EF 23 23
18186:7E FE 9E C2 C8 47 2B 2B
18194:19 13 13 06 04 7E FE 9E
18202:C2 C8 47 19 10 F7 C9 00
18210:00 C2 C8 47 19 10 F7 2A
18218:D0 40 11 20 00 19 7E FE
18226:9E C2 C8 47 19 2B 13 06
18234:04 7E FE 9E C2 C8 47 19
18242:10 F7 7E FE 9E C2 C8 47
18250:23 23 06 03 7E FE 9E C2
18258:C8 47 23 10 F7 19 2B 7E
18266:FE 9E C2 C8 47 2B 2B 2B
18274:2B 7E FE 9E C2 C8 47 C9
18282:3A 7C 40 FE 01 CA A1 47
18290:2A D0 40 11 21 00 C6 00
18298:ED 52 7E FE 9E C2 C8 47
18306:19 2B 2B 7E FE 9E C2 C8
18314:47 19 23 7E FE 9E C2 C8
18322:47 23 23 06 02 7E FE 9E
18330:C2 C8 47 23 10 F7 C9 2A
18338:D0 40 11 C5 00 19 06 03
18346:7E FE 9E C2 C8 47 23 10
18354:F7 11 1D 00 19 7E FE 9E
18362:C2 C8 47 23 23 23 23 7E
18370:FE 9E C2 C8 47 C9 7E FE
18378:9E C8 FE C9 20 06 3E 02
18386:32 50 46 C9 3E 03 32 50
18394:46 C9 02 02 01 00 21 55
18402:7D 22 D0 40 3E 01 32 50
18410:46 21 02 02 22 7B 40 CD
18418:94 40 CD D5 42 CD D2 40
18426:CD DC 44 CD 46 49 C9 CD
18434:8B 40 CD BB 02 7C FE FF
18442:28 F8 3E 02 32 DF 47 2A
18450:7B 40 22 DC 47 3E 01 32
18458:DE 47 3A DE 47 FE 02 28
18466:03 CD 8F 44 CD 0C 42 ED
18474:5B DC 47 3A 7B 40 BB 20
18482:06 3A 7C 40 BA 28 05 3E
18490:02 32 DE 47 3A DF 47 3D
18498:32 DF 47 20 D5 CD BB 02
18506:7C FE FD 20 05 3E 02 32
18514:7B 40 CD 51 46 3A 50 46
18522:FE 02 28 34 CD 15 42 CD
18530:0C 42 CD 0C 42 3A 50 46
18538:FE 01 28 9E 06 04 3A 0E
18546:42 4F 81 10 FD 32 0E 42
18554:CD 0C 42 CD 9F 41 CD 0C
18562:42 CD 82 40 CD 94 40 CD
18570:D3 42 3E 03 32 21 40 C9
18578:06 04 3A 0E 42 4F 81 10
18586:FD 32 0E 42 CD 0C 42 CD
18594:82 46 CD 0C 42 CD 82 40
18602:3E 04 32 21 40 C9 7B 40
18610:3E 05 32 7C 40 3A 7B 40
18618:FE 01 28 27 2A D0 40 23
18626:0E 07 06 04 7E 23 77 2B
18634:2B 10 F9 23 3E 9E 77 11
18642:24 00 19 0D 20 EC CD 0C
18650:42 3A 7C 40 3D C8 32 7C
18658:40 18 D9 2A D0 40 2B 0E
18666:07 06 04 7E 2B 77 23 23
18674:10 F9 2B 3E 9E 77 11 1E
18682:00 19 0D 20 EC CD 0C 42
18690:3A 7C 40 3D C8 32 7C 40
18698:18 D9 9E 9E 99 9E 9E 9E
18706:2A 99 9E 9E 9E 2A 99 9E
18714:9E 9E 2A 9E 9E 9E 9E 2A
18722:22 9E 9E 9E 2A 64 95 9E
18730:9E 0A 64 A2 9E 9E 17 1E
18738:97 9E 9E 17 1E 63 1E 22
18746:1E 1E 1E 32 1E 1E 1E 1E
18754:A2 1E 1E 1E 1E 1E 11 0C
18762:49 21 0F 67 0E 0C 06 05
18770:1A 77 13 23 10 FA D5 11
18778:1C 00 19 D1 0D 20 EF C9
18786:18 00 04 0D 00 F8 06 38
18794:2A 26 00 32 2E 33 2A B8
18802:0D 76
```

Program 2.

```
10 DIM T$(342)
20 FOR N=1 TO 342
30 INPUT B
40 LET T$(N)=CHR$ B
50 PRINT CHR$ B;
60 NEXT N
```

Listing 1.

```
153 54 34 34 46 46
14 34 34 23 23 139
30 23 34 34 34 140
23 23 34 1 30 23
158 153 153 14 34 34
14 46 34 34 34 140
23 140 34 23 23 23
34 23 139 30 17 23
158 158 158 153 54 3
34 34 23 140 34 34
23 23 23 139 30 23
22 139 30 30 139 23
29 29 29 151 162 151
151 162 151 151 162 50
30 30 151 143 50 162
151 151 50 30 50 50
158 11 11 150 150 150
151 138 138 50 50 50
162 162 162 162 50 162
162 162 138 170 30 30
158 158 158 11 150 151
151 151 151 162 162 162
162 143 143 30 30 30
30 50 50 50 162 50
158 158 158 11 151 162
162 151 151 138 50 162
11 158 158 29 151 151
162 151 11 158 158 158
158 158 158 158 11 150
151 151 151 11 158 151
158 151 151 151 11 158
150 151 151 150 158 158
158 158 29 150 151 151
151 151 11 158 29 150
151 162 151 151 11 158
158 11 151 162 162 151
158 46 14 34 54 15
158 158 46 158 158 153
3 23 34 23 23 34
46 34 54 153 158 158
158 158 158 153 3 3
34 34 23 34 153 158
158 46 158 158 46 158
46 34 14 46 34 158
158 158 158 158 158 46
46 46 34 34 14 46
46 34 23 23 34 46
158 158 158 46 46 158
11 11 151 25 50 151
162 50 50 44 19 55
138 50 50 30 50 30
29 29 29 6 62 143
143 30 30 158 158 46
34 57 140 23 23 46
153 14 34 34 140 23
23 17 155 158 15 34
46 29 20 30 23 30
```

All aboard the Dragon express with John Nash for speed and economy.

6809

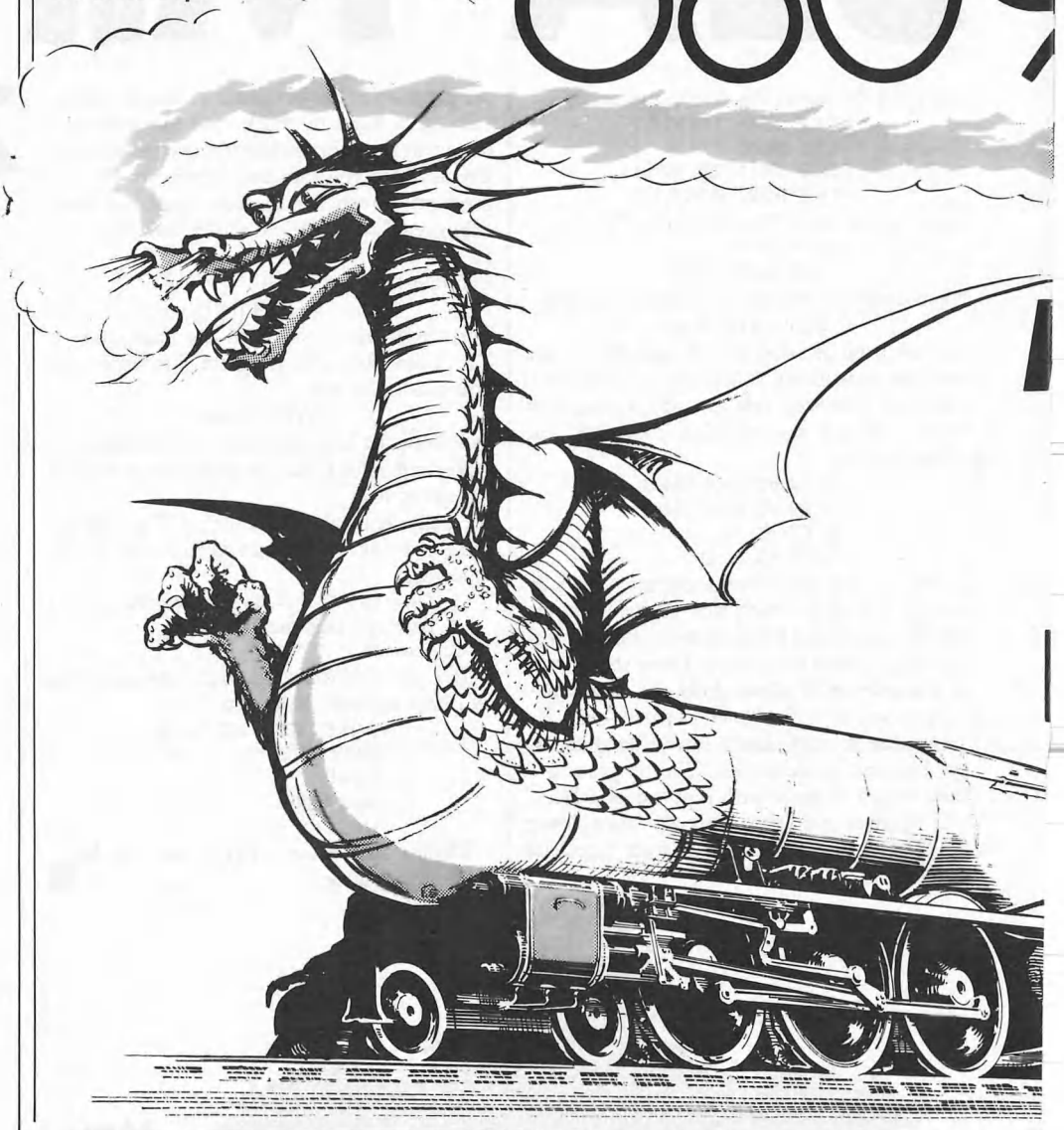


Figure 1a.

```
10 PMODE4:PCLS:SCREEN1,1
20 FORN=1536 TO 7679:POKEN,192:NEXT
```

Figure 1c.

```
00100          ORG     32250
00110 INIT     LDA     #192
00120          LDX     #1536
00130 LOOP     STA     ,X+
00140          CMPX    #7679
00150          BHS     OUT
00160          BRA     LOOP
00170 OUT      RTS
00180          END
```

Figure 2.

```
00100          ORG     32250
00105 START    LDU     #100
00110 INIT     LDA     #192
00120          LDX     #1536
00130 LOOP     STA     ,X+
00140          CMPX    #7679
00150          BHS     OUT
00160          BRA     LOOP
00170 OUT      LEAU    -1,U
00180          CMPU    #0
00190          BEQ     FINISH
00200          BRA     INIT
00210 FINISH   RTS
00220          END
```

Figure 3.

```
00100          ORG     32000
00110 SSTART   LDY     #32512
00120          LDX     #4639
00130 STLOOP   LDA     ,X
00140          STA     ,Y+
00150          LEAX    32,X
00160          CMPX    #7679
00170          BEQ     STDONE
00180          BRA     STLOOP
00190 STDONE   LDX     #7679
00200 MLOOP    LDA     ,-X
00210          LEAY    1,X
00220          STA     ,Y
00230          CMPX    #4608
00240          BEQ     RSTART
00250          BRA     MLOOP
00260 RSTART   LDY     #32512
00270          LDX     #4608
00280 RELOOP   LDA     ,Y+
00290          STA     ,X
00300          LEAX    32,X
00310          CMPX    #7648
00320          BEQ     REDONE
00330          BRA     RELOOP
00340 REDONE   RTS
00350          END
```

Figure 4d.

```
1 REM MACHINE CODE DECIMAL LOADER
2 REM PUT THE CODES INTO DATA STATEMENTS, AS MANY AS YOU NEED, BETWEEN LINES 10
- 49.
3 REM THEN RUN THE PROGRAM AND ANSWER THE PROMPTS.
4 REM FOR THE FIRST BLOCK OF MACHINE CODE FOR THE FLIGHT SIMULATOR, S WOULD BE 3
2256, AND N WOULD BE 182.
5 REM SET THE PARTITION BEFORE YOU START, E.G. CLEAR1000,32250
10 DATA20,FF,7F,40,etc.
20 DATAetc.
50 INPUT"STARTING ADDRESS DECIMAL:";S:S=S-1
60 INPUT"NUMBER OF CODES, DECIMAL";N
70 FORX=1 TO N:READA$:POKE(S+X),VAL("&H"+A$):NEXTX
71 REM TO LOAD DECIMAL CODES, LINE 70 WILL BE: FORX=1 TO N:READA:POKE(S+X),A:NEX
TX
80 CLS:PRINT"COMPLETE. NOW SAVE IT AS A","M/C TAPE FILE AND THEN ERASE ","THIS B
ASIC PROGRAM"
```

Figure 1b

```
FORTH PROGRAM TO FILL SCREEN WITH STRIPES

: FILLSCREEN 7680 1536 DO 192 C! LOOP ;

: SWITCHON 0 65475 C! 0 65477 C! 0 65479 C! 255 65314 C! ;

: REVERT 7 65314 C! ;

: TEST SWITCHON FILLSCREEN REVERT ;

Comment- switchon puts display into hires. and revert goes back to text.
```

THE DRAGON is a fast computer by current standards, and much of the credit for this must go to its excellent processor, the 6809E. The Basic is also one of the fastest available in a home micro. So why use machine code? And when do you need to use it?

There are two principal reasons for using machine code: speed and efficiency. First, speed. Consider the programs in figure 1, which all fill the high-resolution screens with stripes. This is done by Poking 192 to every address from 1536 to 7679. In Basic this takes 41 seconds, in Forth, 1.17 seconds, and in machine code, 0.11 seconds. So the interpreted language, Basic, is nearly 400 times slower than machine code, and even the

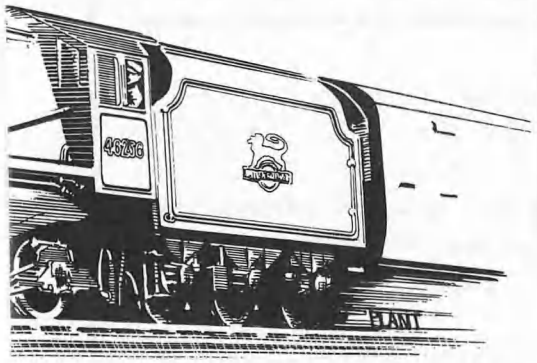
Figure 4e.

```
10 REM STRIPE TEST
20 PMODE3:PCLS:SCREEN1,1
30 EXEC32250
40 GOTO40
```

```
10 REM LATERAL SCROLL TEST
20 PMODE4:PCLS:SCREEN1,1
30 CIRCLE(128,96),95
40 EXEC32000
50 GOTO50
```

EXPRESS

MACHINE CODE FOR THE DRAGON



compiled language, Forth, is 10 times slower. Why the difference?

Imagine you are on holiday in France, and do not speak any French. You would have to look up every word in the dictionary. This is what Basic has to do when it runs. Unlike you, however, it does not learn, and so will not improve with practice.

You might, alternatively, use a phrase book, which would be quicker. This is analogous to Forth, in which you compile your "words" before running the program. The best method, however, would be to learn fluent French, and this would provide the fastest communication of all. This is what you are doing with machine code — talking the machine's own language.

Second, efficiency. Machine code takes up far less space than Basic because the instructions are more compact, and the storage of numbers or variables also takes far less space for most applications. The saving in space can be very important if you want to keep most of the Dragon's memory free for data storage in, say, a file or word-processor program.

You could ambitiously start writing arcade games in machine code, but I would advise gaining some experience on simpler programs first. As a start, if any repetitive procedure in Basic is too slow, put it in machine code and then call it from your Basic program. This will give a staggering improvement in graphics games, as well as text handling programs. Machine-code programs can be called from Basic using the Exec (address) instruction.

Machine-code programming is much faster and easier if you have an assembler. In fact, if you intend to do any serious machine-code programming, an assembler will be essential. They are available in both tape and cartridge versions, the cartridge ones being more convenient and using less memory, but usually at a higher cost. As an example, I shall describe Tandy's Edtasm, which is the one I use.

Really intended for the Color Computer, this cartridge nevertheless works well with the Dragon, although ROM differences prevent a few of the system commands from working. This is not serious, as there are simple alternative ways of achieving the same ends. I include details of how to do this in an appendix at the end of this article. It is a superb system, from Microsoft, and sits in the 8K cartridge area of memory.

It enables you to enter, edit and assemble programs in 6809 mnemonics, and direct the code to anywhere in the RAM. Good error messages are produced, and the package includes the standard Microsoft Editor, and many other functions such as renumber. A separate program, also in the cartridge, called Zbug, enables you to alter or inspect memory or 6809 registers, run programs with breakpoints or by single-stepping, and many other debugging functions. It also contains a useful decimal to hexadecimal and octal converter, as well as a calculator.

The assembler uses the RAM addresses from 600h onwards, and the program listing starts at 800h. This area of memory is the high-resolution. screens, which can of course be overwritten by graphics programs. Thus it is usually best to assemble machine-code subroutines to the end of memory, say 7E00h. It is also essential to store a copy of the assembler text program on tape before running or returning to Basic. Returning to Basic clears the assembler text buffer, but conversely, the assembler will not corrupt the Basic unless you are handling an enormous program which reaches beyond 7680 decimal — 1E00 hexadecimal — which is the usual starting address for the Basic program, with the default setting of PClear4. Thus, machine code and Basic programs can coexist in the machine, and using the assembler need not destroy your Basic. Fitting programs into the memory will be covered in more detail in a later article.

Many useful machine-code routines, and indeed many programs, have the general form:

- Do something
- Increment counter
- Check to see if you have reached limit
- If so, stop: if not, repeat procedure

In Basic, this is the For-Next loop. Another frequently-used one is the conditional test:

- Do procedure
- Test some parameter
- If it = A then go elsewhere
- If it = B then repeat

These two general forms embrace quite a high proportion of programs or subroutines. They are fairly easy to code in machine code the only real difficulty is stating the problem clearly. See for example, figure 1 again. The left-hand column contains the symbols or labels which are used for your convenience. The assembler will convert them to numbers representing addresses as necessary.

The next column contains the commands. These are the actual machine-code instructions. The third column contains the operands: the numbers on which the instructions will operate, which may represent numerical data, or addresses.

The last column is for comments — ignored by the assembler. Line numbers are also provided by the system monitor; these two are ignored by the assembler.

Now to dissect the routine in detail:

LDA #192: This loads the eight-bit A register with 192d, # indicates immediate addressing,

(continued on page 129)

Figure 4a.

```
7DFA                00100          ORG     32250
INE AT ADDR. 32250
7DFA 86   C0        00110 INIT     LDA     #192
7DFC 8E   0600      00120          LDX     #1536
7DFF A7   80        00130 LOOP     STA     ,X+
7E01 8C   1DFF      00140          CMPX    #7679
7E04 24   02        00150          BHS     OUT
7E06 20   F7        00160          BRA     LOOP
7E08 39             00170 OUT      RTS
          0000      00180          END
00000 TOTAL ERRORS
INIT    7DFA      LOOP    7DFF      OUT     7E08
```

Fibure 4b.

```
7DFA                00100          ORG     32250
INE AT ADDR. 32250
7DFA CE   0064      00105 START    LDU     #100
7DFD 86   C0        00110 INIT     LDA     #192
7DFF 8E   0600      00120          LDX     #1536
7E02 A7   80        00130 LOOP     STA     ,X+
7E04 8C   1DFF      00140          CMPX    #7679
7E07 24   02        00150          BHS     OUT
7E09 20   F7        00160          BRA     LOOP
7E0B 33   5F        00170 OUT      LEAU    -1,U
7E0D 1183 0000      00180          CMPU    #0
7E11 27   02        00190          BEQ     FINISH
7E13 20   E8        00200          BRA     INIT
7E15 39             00210 FINISH   RTS
          0000      00220          END
00000 TOTAL ERRORS
FINISH  7E15      OUT     7E0B
INIT    7DFD      START   7DFA
LOOP    7E02
```

Figure 4c.

```
7D00                00100          ORG     32000
7D00 108E 7F00      00110 SSTART   LDY     #32512
7D04 8E   121F      00120          LDX     #4639
7D07 A6   84        00130 STLOOP   LDA     ,X
7D09 A7   A0        00140          STA     ,Y+
7D0B 30   88 20     00150          LEAX    32,X
7D0E 8C   1DFF      00160          CMPX    #7679
7D11 27   02        00170          BEQ     STDONE
7D13 20   F2        00180          BRA     STLOOP
7D15 8E   1DFF      00190 STDONE   LDX     #7679
7D18 A6   82        00200 MLOOP    LDA     ,-X
7D1A 31   01        00210          LEAY    1,X
7D1C A7   A4        00220          STA     ,Y
7D1E 8C   1200      00230          CMPX    #4608
7D21 27   02        00240          BEQ     RSTART
7D23 20   F3        00250          BRA     MLOOP
7D25 108E 7F00      00260 RSTART   LDY     #32512
7D29 8E   1200      00270          LDX     #4608
7D2C A6   A0        00280 RELOOP   LDA     ,Y+
7D2E A7   84        00290          STA     ,X
7D30 30   88 20     00300          LEAX    32,X
7D33 8C   1DE0      00310          CMPX    #7648
7D36 27   02        00320          BEQ     REDONE
7D38 20   F2        00330          BRA     RELOOP
7D3A 39             00340 REDONE   RTS
          0000      00350          END
00000 TOTAL ERRORS

MLOOP   7D18   SSTART  7D00
REDONE  7D3A   STDONE  7D15
RELOOP  7D2C   STLOOP  7D07
RSTART  7D25
```

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(continued from page 127)

i.e., a number.

LDX#1536: this loads the 16-bit X register with 1536d — the start of hi-res screens

We have now initialised, and are about to enter the looping part of the program.

STA ,X+: this is a useful instruction which takes advantage of the auto-index facility of the X register. Do not worry about the details at the moment: addresing will be covered in a future article. What this instruction does is to store the contents of A, 192, in the register 1536 whose address is in the X register, then increment X by one, making it 1537.

CMPX#7679: compares the contents of X, 1537, with the number 7679 and sets a flag to indicate the result.

BHS OUT: checks the flag, and branches to Out if X was the same as or higher than 7679.

BRA LOOP: if we had not finished, we would not branch to Out and so reach this instruction — Branch Always to Loop.

Finally, if we reached Out, we encounter RTS, which is simply Return From Subroutine. Note that, when running programs from the monitor cartridge, you may need SWI — software interrupt — instead. See your own assembler manual.

END: this is an instruction to the assembler that it has finished and can now relax. End is not compiled as a machine-code instruction.

Now look at figure 2. This routine uses the 16-bit U register as an additional counter to repeat the loop 100 times. LDU#100 is fairly straightforward, but what is the LEAU — 1,U doing? This is an example of the Load Effective Address or LEA instruction, to be discussed in more detail in a future article. It subtracts 1 from the value in the U register.

BEQ is another branch instruction: Branch on Equal. This only branches when the two values being compared are equal.

Finally, look at figure 3. This is a program to scroll part of the screen one byte at a time, laterally. This could be useful in a program of the scramble type, for example, to move the ground. See if you can work out how it works; hint — it stores the value of the end byte of each line before scrolling, and puts these back to the opposite end of the screen to achieve wrap around.

What if you do not have an assembler? You will find programming more difficult, as you cannot use labels, and all branch instructions have to be converted to relative addressing. You would also be well advised to stick to hexadecimal numbers, as this will save errors in conversion and other misunderstandings.

If you do not understand hexadecimal numbers, you will find useful sections on base arithmetic in most school maths textbooks. Another concept you will need to grasp is two's complement arithmetic, which is needed for calculating relative addresses for branch instructions.

As this applies to eight-bit arithmetic, you can find the two's complement of a decimal number by subtracting it from 256, and then converting to h. Thus the largest positive eight-bit or 2c number is 127 — 7F — and the largest negative number is — 128 — 80 h.

For the present, however, I have given the full assembly listings of the programs in the article, in figure 4. The extra three columns of the assembler listing in figure 4 are, left to right, address, command, operand — all in h. To enter these codes, use the short Basic program also shown in figure 4d. This is the standard machine-code loader, and can be used for loading either d or h codes by modifying line 70 as shown. When loaded, the routines can be run from Basic using an Exec or Address command.

The most important Edtasm functions which do not match up with the Dragon ROM are Q — quit, to Basic — and tape saving. I have found the following methods suitable: to return to Basic, get into Zbug and type GB400. This restarts the Basic system, but also clears your Basic program. GB4AA will also restart Basic and leave your Basic program intact which saves time.

This address, however, does not restart Basic quite properly, because the first RAM operation will give an OM error. Just carry on, and you will find that the system is then back to normal. I usually purge this error by typing 7E as part of the restart procedure.

To Save files to tape, I first use Zbug's U or block transfer function to make a copy of the file at a safe address: 16000 is suitable. I copy the addresses from 600h to about 0C00 for a short program, or 1400h for a long one. Once the copy is made, I return to Basic as above, and immediately tape the file using Basic's CSaveM function in the usual way, copying the block from 16000d onwards. To reload, I reverse the procedure, first loading the tape file to 16K onwards, then starting up Edtasm with Exec 49152, then using the U function to copy the file from 16000 back to the editing/assembling area starting at 600h. ■

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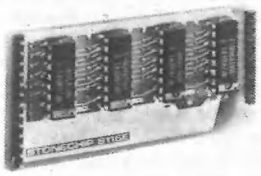

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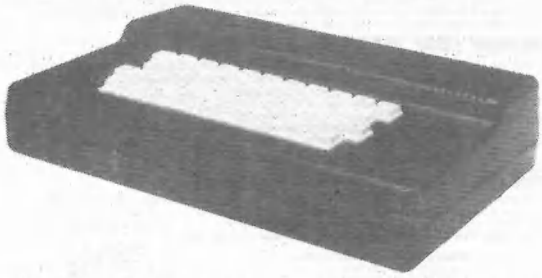

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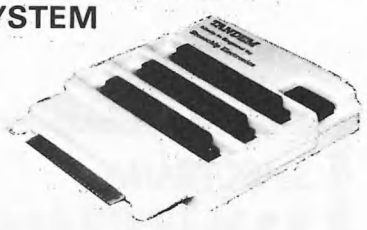

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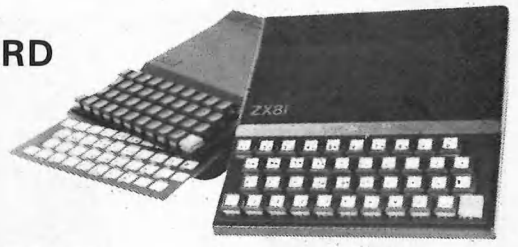

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"Let me look at that" I said and after another 10 or 15 seconds up came the paragraph in *Birch's Medical Emergencies* in which acupuncture is mentioned as one cause of a penetrating wound of the chest wall. The reference is so slight that it might well not appear in the formal index to the book but Colleague, a new medical information retireval service, had found it from among thousands of millions of stored characters and words.

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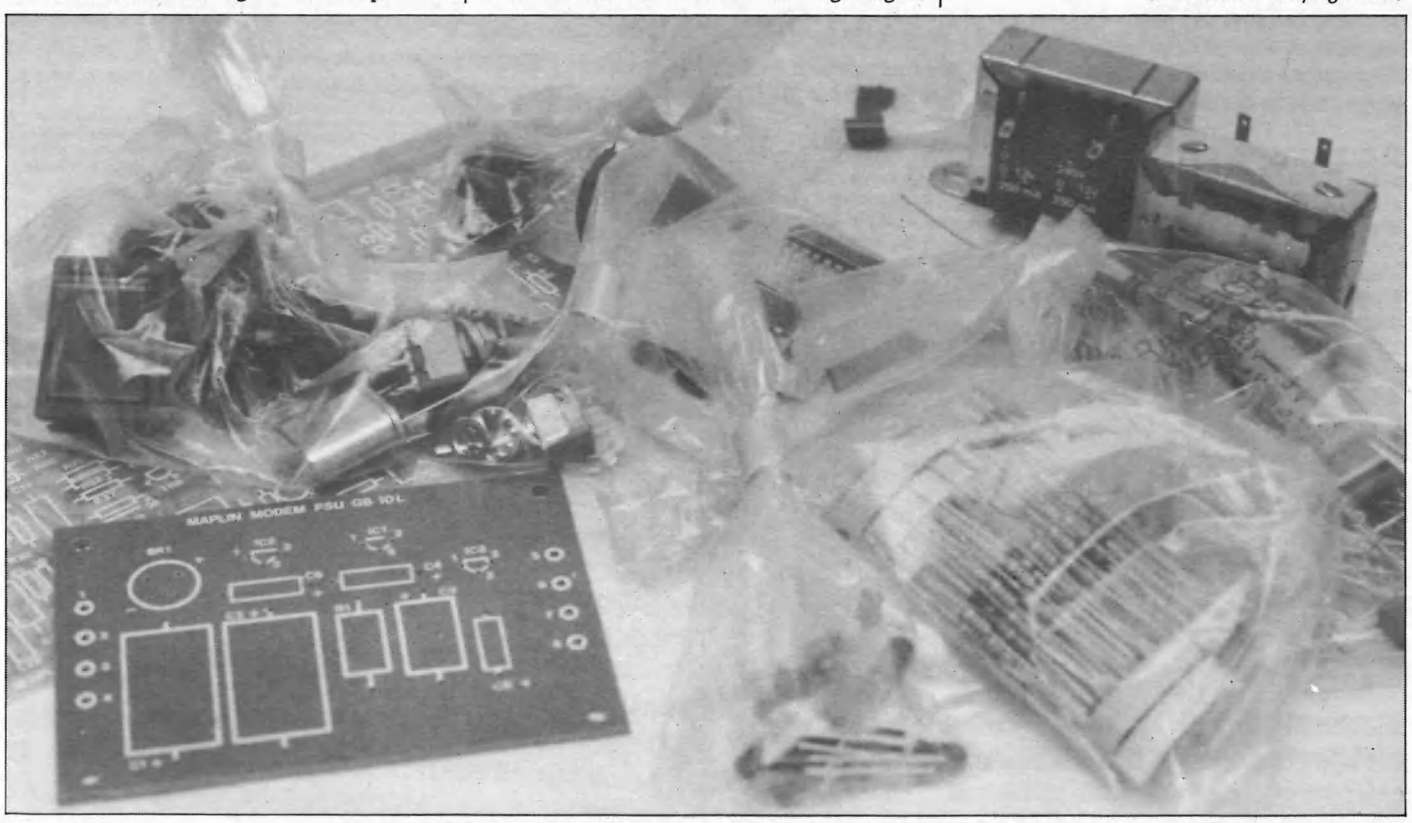
(continued on page 135)



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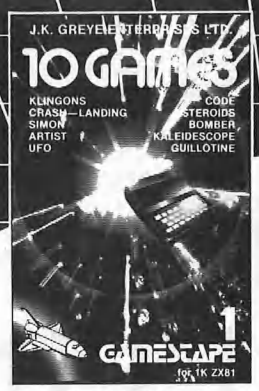

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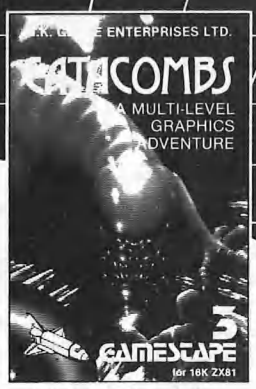

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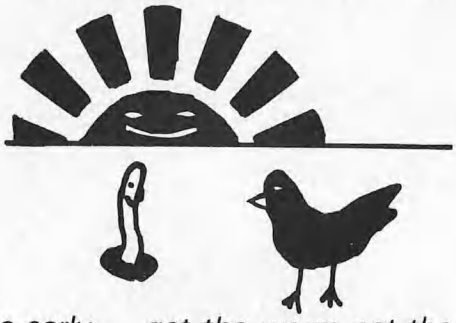

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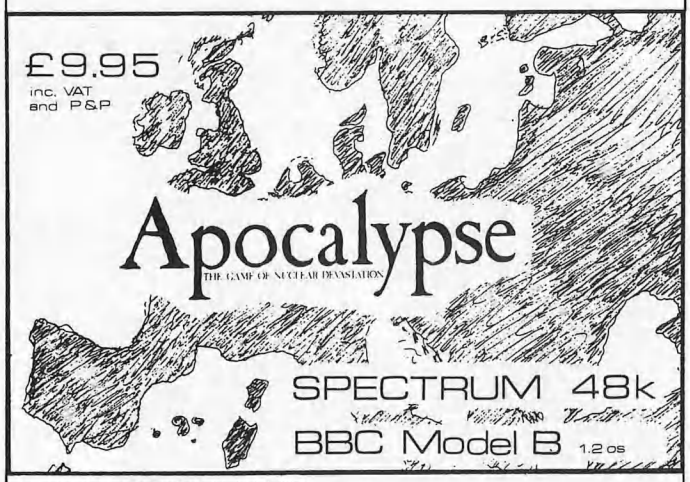

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(continued from page 133)
when you think about Prestel, the flow is unequal — there is comparatively little information going from me to the computer and a great deal coming back from the computer to my visual display unit.

Within a computer, data is transmitted along parallel or serial buses in digital form, so the signal is either on or off. The standard RS-232C protocol was intended originally to connect one part of a computer to another, a line printer, for example, to the central processor unit. The RS-232C protocol is fairly robust in operation — I have used a printer connected directly to a Televideo 950 terminal by 50 metres of cable at 2400 Baud without any difficulty — but it was never intended to span the Atlantic and would fail before you had crossed the low water mark of a Cornish beach.

Modems are pieces of equipment that turn the digital electrical signals used by computers into analogue signals suitable for transmission over long distances. The term Modem is contracted from the two words modulator and demodulator because the purpose of the equipment is to impose the digital signals from the computer on to a carrier signal — to modulate the carrier — while the digital information is recovered at the far end by the opposite process of demodulation.

Microcomputers almost invariably use a form of transmission known as asynchronous communication. Asynchronous communication is transmission in which each information character is individually synchronised by the use of start and stop elements because the interval of time between characters can vary. Synchronous transmission is used more often between large computers because the equipment and software exists to hold the elements of the computer rigidly in time with each other. Information can also be transmitted more rapidly as there is no need to add start and stop bits to the front and end of every character.

The actual rate of transmission may be very fast using a synchronous protocol — hundreds of thousands or millions of characters per second. Asynchronous protocols such as that used by Prestel or Colleague, or any system utilising the Public Switched Telephone Network, or PSTN, work more slowly. Prestel takes information from the user at about 7.5 characters per second and transmits information at about 120 characters per second. Colleague will adjust itself automatically to the equipment of the user and can accommodate up to 120 characters per second. That is the practical limit for an ordinary telephone line and often 30 characters per second, which corresponds to 300 Baud, is the fastest rate that will get a message down a line without disabling corruption.

Special telephone lines will handle faster data transmission rates but, in return, you lose portability because the equipment is effectively fixed to the end of the special line and the rental costs rise considerably.

Amateur or domestic microcomputer users in the USA are well ahead of their British counterparts in terms of connecting Modems to their microcomputers, although the British Prestel system has the largest number of users of any videotext system in the world. The previous attitudes of the GPO, now British Telecom, contributed significantly to the lack of progress in this country. Modems have to be approved by the Post Office or BT and that used to be a long drawn out and frustrating procedure.

Renting a Post Office Modem was expensive and the installation delays were enough to make many people consider the advantages of carrier pigeons. These attitudes are changing and may be expected to continue to become more customer friendly as microcomputer users start to explore outside the limited applications that are possible using an isolated system.

Networking was one of the buzz-words of last year or the year before, but it is true that the ability to communicate with other machines is a key element in the development of information technology. The Colleague system would be impossible to implement without Modems and the ordinary, familiar telephone in your office or home.

Commercial Modems are still quite expensive although some acoustic couplers — devices that use the telephone handset to transmit and receive the tones that form the modulated carrier signal rather than making direct electrical connection to the telephone line — have become cheaper in the last year.

Maplin Electronic Supplies has produced a direct connection Modem as a kit and a number of interface boxes that will connect the Modem to a range of domestic microcomputers. The Maplin Modem is cheap and, according to research workers and doctors who are using it, highly satisfactory.

The photograph on page 133 shows the components of the Modem as it arrived for this review. The main board is a single sided glass fibre board of good quality. The tracks are all tinned and there is no additional gold-plating on the connections to the plug from which wires lead to the power supply and the isolating transformer. This is really not necessary, however, as you are unlikely to plug and unplug the board from the socket on more than a few occasions.

The components are all of a high standard and many of the resistors are rated as one per cent accurate using the new four-band colour codes. The Modem transmits and receives at the single speed of 300 Baud and uses standard European CCITT tones. One of the chips used in the Modem kit can be configured to generate American tones although this is not mentioned further in the excellent construction notes. The Modem uses a British Telecom approved isolating transformer and may be submitted after construction to the appropriate local BT office for official clearance.

The kit contains between 80 and 90 resistors and it took me some time to locate the position for each of these as the board does not follow an obvious left to right plan for the component numbering. However, the silk screened component layout is clear and you should have no difficulty in completing the construction of the board provided you do not rush.

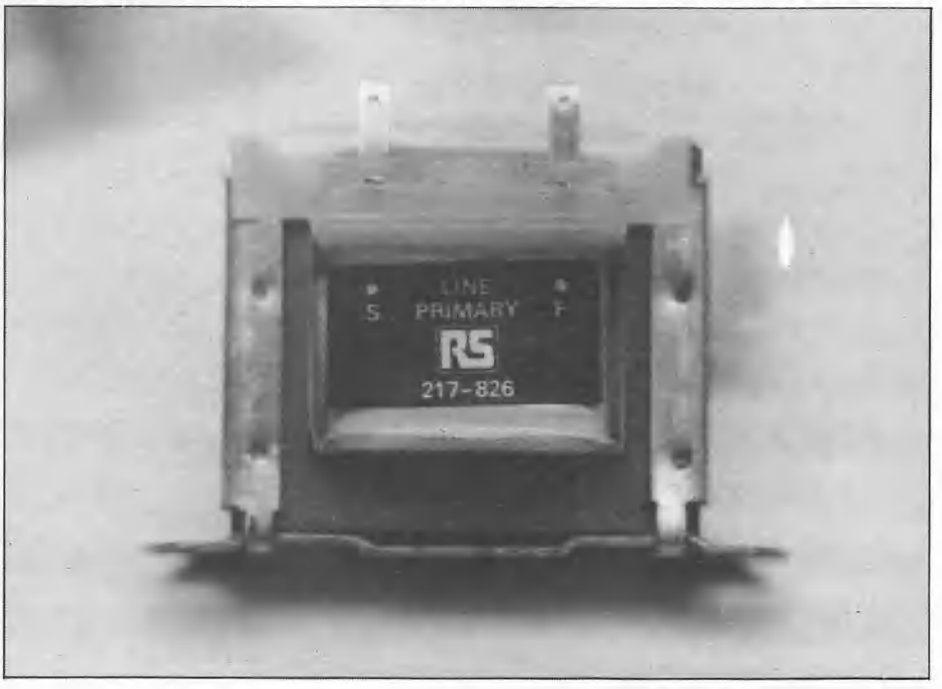
Many of the resistors' values have had to be synthesised from two components to match the calculated values for the bandpass filters. Incorrect assembly will degrade the performance of the filters — these are the key elements of the Modem design.

The construction notes suggest that you will need an oscilloscope to complete the setting up procedure and I cannot see any way of avoiding those stages other than by pure luck. The procedure is not hard to follow but you will require access to an oscilloscope and a voltmeter for routine voltage checking. The kit of parts contained a slip correcting some errors in the construction notes and one replacement resistor which has been substituted for a different value in the original design was wrapped in a separate plastic bag. This degree of attention to detail is unusual among kit suppliers and indicates a welcome concern by Maplin Electronics that you should succeed in building and operating the Modem.

Maplin, incidentally, is sufficiently sure of the quality of the Modem to have started Cashtel, a computerised shopping service. You can dial 0702 552941 and access the Maplin computer which will give you details of any item in the Maplin catalogue, including the quantity currently in stock. Using a credit card number and a special Maplin shopper's number you can then order what you want.

Remember that a Modem is a piece of hard-

(continued on page 137)



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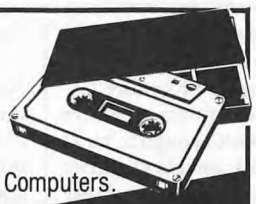

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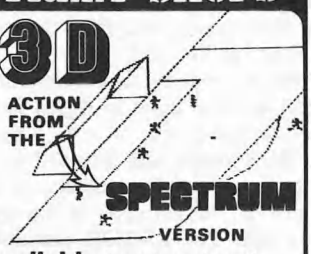

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SINCLAIR USER FEBRUARY 1983

Although I'm no great football fan, I really enjoyed playing this game — excellent use is made of colour and user-defined graphics. The game is very logically put together, so that the development of strategy and tactics has a real effect. For example, one of my teams got through to the fourth round of the F.A. Cup where it was beaten by a second division side. This upset morale and meant that our promotion bid failed. Perhaps I should have given up the F.A. Cup run and held some good players back — the possibilities are endless. Brian Clough had better watch out!
* SPECTRUM VERSION ONLY. **ZX COMPUTING FEB/MARCH 1983**

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REMEMBER . . . time is all important—so!

(continued from page 135)
ware that extends the electrical connections you can make with your microcomputer. The software that will program the computer to make use of the Modem is another matter. Prestel software is well suited to some jobs and not to others. The Colleague software is enormously sophisticated and is far more suitable for many information retrieval purposes.

Both of these systems demand almost no machine intelligence at the user's terminal; Prestel requires only a numeric keypad as the minimum input capability and Colleague will work quite adequately with a dumb alphanumeric terminal. For some tasks you will need programs to transfer information from disc to the Modem or vice versa.

The PIP, or Peripheral Interface Program, in CP/M can be used to set up a serial port as the chosen input and output device and I have seen two RML 380Z computers connected through two Maplin Modems and sharing files after less than 20 minutes work configuring PIP.

The social and political effects of such a simple device as a Modem are far-reaching and should not be dismissed. Research workers in university medical departments have complained loudly and with justification about the effects of cuts on medical staffing. However bad that situation is, there is no doubt that many professors are even more worried about staffing levels among technical and clerical staff. If a department is unable to keep its filing up to date then after a few years there will be no working reference system and research staff will be unable to read about work in progress at similar centres in other countries and the

MODEM

quality of UK research will suffer immeasurably.

If a professor or senior lecturer spends time doing his or her own filing then other work does not get done and that is a grossly uneconomic way to spend a senior lecturer's salary. Colleague may be the way out of this impasse. If the full text of the original papers you need is available on demand, and if it is easier to find because your own alternative is a card index or a simple electronic equivalent on a microcomputer, then Colleague looks very attractive.

But without a paper hard copy of the original how can you guarantee that it is as the author wrote it? Do you remember Winston Smith's job in George Orwell's *1984?* He worked for the Ministry of Information "rectifying" inaccuracies in *The Times* and other newspapers:

"times 17.3.84 bb speech malreported africa rectify" said the internal Ministry of Information memorandum. "The messages he had received referred to articles or news-items which for one reason or another it was thought necessary to alter . . . it appeared . . . that Big Brother, in his speech of the previous day, had predicted that the South Indian front would remain quiet but that a Eurasian offensive would shortly be launched in North Africa . . . It was therefore necessary to rewrite a paragraph of Big Brother's speech . . . when any particular number of *The Times* had been assembled and collated, that number would be reprinted, the original copy destroyed, and the corrected copy placed on the files in its stead . . . Day by day and almost minute by minute the past was brought up to date."

Now 1984 is only four months away and who needs all those staff to collate and reprint and file paper copies when it can all be stored on cheap magnetic and video discs, accessed instantly and "rectified"? Would it not be convenient to modify something personally or politically inconvenient just a little bit. Even in research there must be a temptation to rewrite the conclusions of an old paper in the light of subsequent experience — change the emphasis here or there to reflect or foreshadow later knowledge.

Unless this technology is managed consciously we shall all be the losers to expediency and opportunism. Electronic communication between machines is an enormously important step — swapping games programs may be trivial but there are many good and serious applications. Choosing those applications and rejecting those that will, or may, cause social or political damage is hard work. ■

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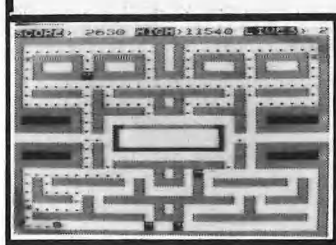

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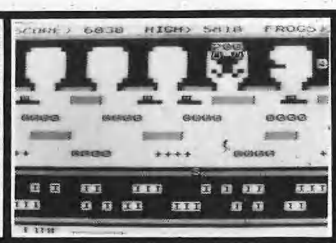

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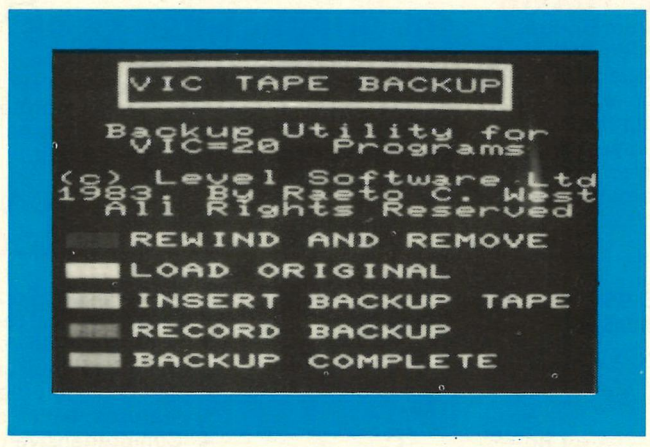

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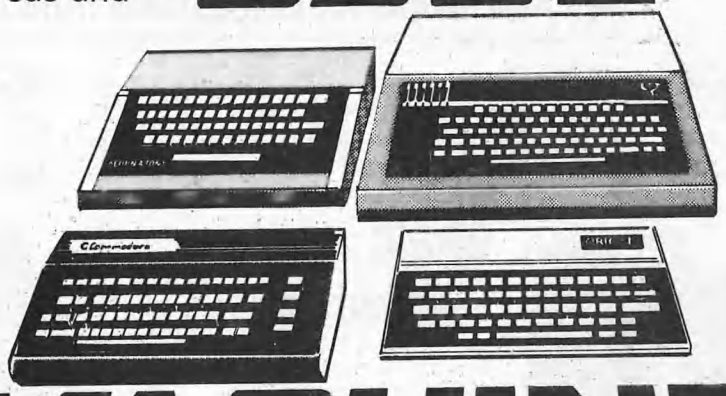

SURELY MOST people who are even vaguely interested in computer games must, at one stage or another, have tried to program a version of space invaders. Although it looks a simple enough task, once all of the checks are in to provide a good game, Basic is invariably far too slow to enjoy this masterpiece. Let us try machine code.

The main programming problems are drawing the screen, moving the invaders from side to side and down the screen, moving the ship from side to side, firing up at the invaders, and scoring. Once these five points have been overcome, frills can be added such as the invaders changing colour, a mystery ship and so on.

The first problem is drawing the screen. The easiest way to do this is just copy a ready-drawn picture of the screen from memory. This is done very quickly using the routine

```
      LDY #00
      LDX (NUMBER OF BYTES TO BE
      COPIED)
LOOP  LDA (SOURCE),X
      STA (DESTINATION),X
      DEX
      BNE LOOP
      RTS
```

where Source is the address of the data to be copied and Destination is the address of where the data is to be copied to.

This routine is used twice, once for the score at the top of the screen and once for the defences at the bottom.

Now we have to plot the invaders. This is done separately from the rest of the Draw routine so that the invaders can be moved to lower start positions every fourth sheet. Although all of the invaders look the same there are really two distinct types; one of these moves from left to right, and moves down a line when it reaches the right, and vice versa. By doing this we can use a groovy little routine which I call the Scan routine.

The operation of this routine can best be seen using the program shown in figure 1 which, as it is in Basic, is slow enough to watch working. But now try and move things down the screen by changing line 30 to

30 IF PEEK(C) = 5 THEN POKE C,32: POKE C + 40,5

(continued on page 143)

Figure 1.

```
2 REM ***** BASIC SCAN ROUTINE
3
4 REM ***** SET UP THE SCREEN
5 C=1063
6 C=C+1:POKEC,32:IFRND(1)<.11THENPOKEC,5
7 IFC<1983THEN6
10 C=1064:REM ***** START OF SCREEN
20 C=C+1:IFC=1983THEN10:REM ***** FINISHED ?
25 REM ***** IF THE CHARCTER ON THE SCREEN IS
26 REM ***** AN 'E' THEN MOVE IT UP
30 IFPEEK(C)=5THENPOKEC,32:POKEC-40,5
35 REM ***** DISPLAY THE COUNTER POSITION
40 PRINT"⌧          ⌧"C
50 GOTO20:REM ***** REPEAT FOR THE NEXT SPACE

READY.
```

Listing 1.

```
10 RESTORE:PRINT"⌧"
15 FORI=0TO15:POKE4*4096+I,0:NEXT:REM RESET VARIABLES
20 READA:IFA=-1THEN100
30 POKE18432+R,A:R=R+1:PRINT"⌧      ⌧"1062-R:W=W+A:GOTO20
100 PRINT"⌧DATA ITEMS ENTERED ="R"  (1062)"
110 PRINT"⌧SUM OF DATA        ="W"  (105351)"
120 IFW=105351THENPRINT"⌧***** CODE OK *****"
130 IFW<>105351THENPRINT"⌧⌧        CODE ERROR        ■"
140 PRINT"⌧HIT ⌧E■ TO START"
150 GETA$:IFA$<>"£"THEN150
160 SYS18432
1000 DATA 32,47,72,32,73,72,32,150,72,32,188,72,32,221,72
1010 DATA 32,2,76,32,62,73,32,174,74,32,105,74,32,5,75
1020 DATA 32,36,75,32,105,74,32,88,75,173,9,64,240,230,76
1030 DATA 45,75,169,32,162,0,157,0,4,157,0,5,157,0,6
1040 DATA 157,231,6,202,208,241,142,33,208,142,32,208,96,169,1
1050 DATA 162,40,157,0,216,202,208,250,169,7,162,0,157,0,217
1060 DATA 157,0,218,202,208,247,169,10,162,255,157,231,218,202,208
1070 DATA 250,169,0,162,40,157,40,216,157,192,219,202,208,247,96
1080 DATA 32,32,32,2,2,2,32,32,32,2,2,2,32,32,32
1090 DATA 2,2,2,32,32,32,32,32,48,48,48,48,48,48,32
1100 DATA 162,20,189,120,72,157,32,7,157,52,7,157,72,7,157
1110 DATA 92,7,157,112,7,157,132,7,202,208,232,162,9,189,140
1120 DATA 72,157,0,4,202,208,247,96,169,255,133,86,169,3,133
1130 DATA 87,160,1,162,23,24,165,86,105,40,133,86,165,87,105
1140 DATA 0,133,87,169,23,145,86,202,208,236,96,173,10,64,24
1150 DATA 106,24,106,170,169,160,133,86,169,4,133,87,138,240,17
1160 DATA 24,165,86,105,40,133,86,165,87,105,0,133,87,202,76
1170 DATA 237,72,160,24,169,0,145,86,24,165,86,105,40,133,88
1180 DATA 165,87,105,0,133,89,169,1,145,88,24,165,88,105,40
1190 DATA 133,88,165,89,105,0,133,89,169,0,145,88,24,165,88
1200 DATA 105,40,133,88,165,89,105,0,133,89,169,1,145,88,136
1210 DATA 136,208,197,169,80,133,86,169,4,133,87,160,1,169,63
1220 DATA 141,191,7,24,165,86,105,1,133,86,165,87,105,0,133
1230 DATA 87,177,86,240,7,201,63,208,235,76,168,73,32,135,75
1240 DATA 160,1,169,32,145,86,160,0,177,86,201,5,208,11,160
1250 DATA 1,32,34,75,32,161,75,76,77,73,201,23,208,11,169
1260 DATA 1,160,41,145,86,160,1,76,77,73,169,0,145,86,160
1270 DATA 1,76,77,73,169,32,145,86,160,41,169,1,145,86,160
1280 DATA 1,76,77,73,169,191,133,86,169,7,133,87,160,0,169
1290 DATA 63,141,40,4,56,165,86,233,1,133,86,165,87,233,0
1300 DATA 133,87,177,86,201,1,240,9,201,6,240,89,201,63,208
1310 DATA 229,96,32,135,75,160,0,169,32,145,86,160,1,177,86
1320 DATA 201,5,208,15,169,32,145,86,160,0,32,34,75,32,161
1330 DATA 75,76,183,73,201,63,208,6,169,1,141,9,64,96,201
1340 DATA 23,208,11,169,0,160,39,145,86,160,0,76,183,73,169
1350 DATA 1,145,86,160,0,76,183,73,169,32,145,86,160,40,169
1360 DATA 0,145,86,160,0,32,35,75,76,183,73,169,32,145,86
1370 DATA 160,40,177,86,201,2,208,9,169,3,145,86,160,0,76
1380 DATA 183,73,201,3,208,9,169,4,145,86,160,0,76,183,73
1390 DATA 201,4,208,9,169,32,145,86,160,0,76,183,73,201,7
1400 DATA 208,6,169,1,141,9,64,96,169,6,145,86,160,0,76
1410 DATA 183,73,160,0,177,90,201,5,240,6,169,1,141,6,64
1420 DATA 96,169,32,145,90,56,165,90,233,40,133,90,165,91,233
1430 DATA 0,133,91,24,165,91,105,212,133,89,165,90,133,88,177
1440 DATA 88,208,1,96,177,90,201,32,240,11,32,34,75,32,161
1450 DATA 75,169,32,145,90,96,169,5,145,90,96,169,32,174,8
1460 DATA 64,157,152,7,32,228,255,208,1,96,201,90,240,9,201
1470 DATA 47,240,19,201,32,240,29,96,173,8,64,201,1,208,1
1480 DATA 96,206,8,64,76,36,75,173,8,64,201,38,208,1,96
1490 DATA 238,8,64,76,36,75,173,6,64,208,1,96,24,169,152
1500 DATA 109,8,64,133,90,169,7,105,0,133,91,169,0,141,6
1510 DATA 64,169,5,160,0,145,90,96,141,0,64,142,1,64,140
1520 DATA 2,64,162,128,160,128,136,208,253,202,208,248,173,0,64
1530 DATA 172,2,64,174,1,64,96,96,96,174,8,64,169,7,157
1540 DATA 152,7,96,169,4,141,10,4,141,13,4,169,5,141,11
1550 DATA 4,169,1,141,12,4,165,86,141,32,208,165,87,141,33
1560 DATA 208,230,86,230,87,32,5,75,32,228,255,240,234,76,0
1570 DATA 72,169,42,133,86,169,4,133,87,160,0,140,7,64,24
1580 DATA 165,86,105,1,133,86,165,87,105,0,133,87,177,86,201
1590 DATA 1,240,14,201,0,240,10,201,63,208,229,238,10,64,76
1600 DATA 0,72,96,173,18,208,201,250,176,1,96,160,40,177,86
1610 DATA 201,32,240,3,160,0,96,169,6,145,86,160,0,96,248
1620 DATA 24,173,3,64,105,1,141,3,64,173,4,64,105,0,141
1630 DATA 4,64,173,5,64,105,0,141,5,64,216,173,3,64,106
1640 DATA 106,106,106,24,105,48,141,3,4,173,3,64,41,15,105
1650 DATA 48,141,8,4,173,4,64,106,106,106,106,24,105,48,141
1660 DATA 7,4,173,4,64,41,15,105,48,141,6,4,173,5,64
1670 DATA 106,106,106,106,24,105,48,141,5,4,173,5,64,41,15
1680 DATA 105,48,141,4,4,96,169,0,141,3,64,141,4,64,141
1690 DATA 5,64,141,9,64,141,6,64,141,7,64,141,33,208,141
1700 DATA 32,208,169,12,141,8,64,96,255,255,247,255,-1

READY.
```

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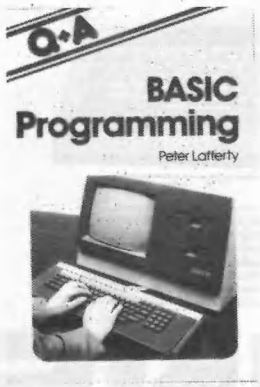

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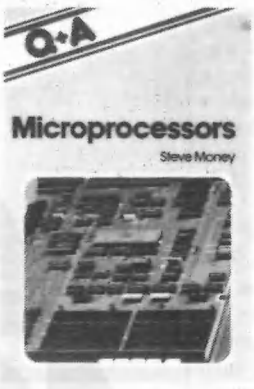

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CS

(continued from page 141)

The results are puzzling at first, but look at it slowly. The pointer will chug along until it finds the first asterisk and it will then move it down one line, a line later it will come across this same asterisk and move it down another line, and another, and another until it comes to the bottom of the screen.

The easiest way to combat this is to scan down the screen if a thing is moving up, and up if it is moving down. This explains why there are two scans. It is these scans which move the invaders and their bullets.

The ship is moved from the keyboard which is a big advantage to those people without a joystick, but a joystick read routine should be quite easy to add.

The input from the keyboard is based upon a routine located at $FFE4. This is a very useful subroutine which is stored in the ROM and used by Basic. When called it looks at the keyboard and return with the keyboard position of the key pressed, or zero if no key is pressed, in the accumulator.

(continued on next page)

SYMBOL TABLE

SYMBOL	VALUE						
BASE	4AAE	BASE1	4ABC	BASE2	4AC9	BASE2A	4AD1
BASE3	4AD7	BASE3A	4ADF	BASE4	4AE5	BASE4A	4AEB
BLEEP	4B22	BLEP	4B21	BLP	4B23	BORD	48BC
BORD1	48C8	BPLOT	4B24	BUL	4A69	BUL1	005A
BUL2	005B	BUL3	4A77	BUL4	4A98	BUL5	4AA9
CLR	482F	CLR1	4833	CMST	D800	COL	4849
COL1	484D	COL2	4857	COL3	4864	COL4	486E
DATA	4878	DATA1	488C	DEAD	4B2D	DEAD1	4B3F
DELAY	4B05	DELAY1	4B10	DELAY2	4B12	DIED	4009
DRAW	4896	DRAW1	4898	DRAW2	48B2	DRINV	48DD
DRINV1	48ED	DRINV2	4901	DRINV3	4903	FLAG	4006
FLAG2	4007	FORE	4B87	FORE1	4B8F	FORE2	4B9A
IINV	49A8	IINV1	49B7	IINV2	49D3	IINV3	4A27
IINV4	49F3	IINV5	49FD	IINV6	4A15	IINV7	4A3C
IINV8	4A49	IINV9	4A56	IINVA	4A60	IJNV3	4990
IJNV5	4A0C	INV	493E	INV1	494D	INV2	4965
INV3	4981	INVA	4999	MAIN	4800	MAIN1	4812
OVER	4B58	OVER1	4B65	OVER2	4B86	PLOT	0056
PLOT2	0058	PLOTT	0057	PLOTT2	0059	POS	4008
RAND	D012	RESET	4C02	SCOR4	4005	SCOR5	4004
SCOR6	4003	SCORE	4BA1	SCST	0400	SHEET	400A
TEMPA	4000	TEMPX	4001	TEMPY	4002		

Listing 2.

```
LINE# LOC  CODE        LINE

00001 0000             ;      PUT '@ INV.15"
00002 0000             ;
00003 0000             ; ========================
00004 0000             ; == BASIC SPACE INVADERS ==
00005 0000             ; ========================
00006 0000             ;
00007 0000             ;WRITTEN FOR THE COMMODORE 64
00008 0000             ;BUT WILL RUN ON MOST 6502
00009 0000             ;BASED MACHINES WITH VERY LITTLE
00010 0000             ;ADAPTIONS
00011 0000             ;
00012 0000             ;
00013 0000             ;START THE CODE AT 4*4096
00014 0000             ;
00015 0000                     *=$4000
00016 4000             ;
00017 4000             ;VARIABLES
00018 4000  00         TEMPA  .BYT 0
00019 4001  00         TEMPX  .BYT 0
00020 4002  00         TEMPY  .BYT 0
00021 4003  00         SCOR6  .BYT 0
00022 4004  00         SCOR5  .BYT 0
00023 4005  00         SCOR4  .BYT 0
00024 4006  00         FLAG   .BYT 0
00025 4007  00         FLAG2  .BYT 0
00026 4008             PLOT   = $56
00027 4008             PLOT1  = $57
00028 4008             PLOT2  = $58
00029 4008             PLOTT2 = $59
00030 4008             BUL1   = $5A
00031 4008             BUL2   = $5B
00032 4008  0C         POS    .BYT 12
00033 4009  00         DIED   .BYT 0
00034 400A             SCST   = 1024
00035 400A             CMST   = 55296
00036 400A             RAND   = 53248+18:RASTER REGISTER
00037 400A  00         SHEET  .BYT 0
00038 400B             ;
00039 400B             ;HERE IS THE MAIN ROUTINE WHICH
00040 400B             ;CALLS ALL OF THE OTHER
00041 400B             ;SUB-ROUTINES
00042 400B             ;
00043 400B             ;
00044 400B                     *=$4800
00045 4800             ;
00046 4800             ;
00047 4800  20 2F 48   MAIN   JSR CLR        ;CLEAR SCREEN
00048 4803  20 49 48          JSR COL        ;COLOR SCREEN
00049 4806  20 96 48          JSR DRAW       ;DRAW  SCREEN
00050 4809  20 BC 48          JSR BORD       ;DRAW  BORDERS
00051 480C  20 DD 48          JSR DRINV      ;DRAW  INVS
00052 480F  20 02 4C          JSR RESET      ;RESET SCORE ETC
00053 4812             ;
00054 4812             ;THE SCREEN SHOULD NOW BE DEFINED
00055 4812             ;
00056 4812  20 3E 49   MAIN1  JSR INV        ;MOVE INVS
00057 4815  20 AE 4A          JSR BASE       ;MOVE BASE
00058 4818  20 69 4A          JSR BUL        ;MOVE BULLET
00059 481B  20 05 4B          JSR DELAY      ;SLOW DOWN
00060 481E  20 24 4B          JSR BPLOT      ;DRAW BASE
00061 4821  20 69 4A          JSR BUL        ;FAST BULLETS
00062 4824  20 56 4B          JSR OVER       ;CHECK FOR END
00063 4827             ;
00064 4827             ;NOW TO CHECK IF ONE IS DEAD
00065 4827             ;IF SO THEN FLAG DIED = 1
00066 4827             ;IF NOT THEN DIED = 0
00067 4827             ;
00068 4827  AD 09 40          LDA DIED
00069 482A  F0 E6             BEQ MAIN1
00070 482C             ;
00071 482C             ;IF THE PROGRAM GETS HERE THEN
00072 482C             ;YOU HAVE DIED
00073 482C             ;
00074 482C  4C 2D 4B          JMP DEAD
00075 482F             ;
00076 482F             ;
00077 482F             ;===== CLEAR SCREEN =====
00078 482F             ;
00079 482F  A9 20      CLR    LDA #32         ;CHR# SPACE
00080 4831  A2 00             LDX #0          ;COUNTER =256
00081 4833  9D 00 04   CLR1   STA SCST,X      ;STORE SPACE
00082 4836  9D 00 05          STA SCST+256,X;OVER THE SCREEN
00083 4839  9D 00 06          STA SCST+512,X;MEMORY
00084 483C  9D E7 06          STA SCST+743,X
00085 483F  CA                DEX             ;IFX<>0THEN
00086 4840  D0 F1             BNE CLR1        ;REPEAT
00087 4842  8E 21 D0          STX 53281       ;SCREEN BLACK
00088 4845  8E 20 D0          STX 53280       ;BORDER BLACK
00089 4848  60                RTS
00090 4849             ;
00091 4849             ;
00092 4849             ;
00093 4849             ;===== COLOUR SCREEN =====
00094 4849             ;
00095 4849  A9 01      COL    LDA #1          ;WHITE
00096 484B  A2 28             LDX #40         ;1 LINE
00097 484D  9D 00 D8   COL1   STA CMST,X      ;SCORE IS WHITE
00098 4850  CA                DEX
00099 4851  D0 FA             BNE COL1
00100 4853             ;
00101 4853  A9 07             LDA #7          ;YELLOW
00102 4855  A2 00             LDX #0          ;256
00103 4857  9D 00 D9   COL2   STA CMST+256,X  ;MIDDLE SCREEN
00104 485A  9D 00 DA          STA CMST+512,X  ;IS YELLOW
00105 485D  CA                DEX
00106 485E  D0 F7             BNE COL2
00107 4860             ;
00108 4860  A9 0A             LDA #10         ;LT RED
00109 4862  A2 FF             LDX #255
00110 4864  9D E7 DA   COL2   STA CMST+743,X;BOTTOM IS RED
00111 4867  CA                DEX
00112 4868  D0 FA             BNE COL3
00113 486A             ;
00114 486A  A9 00             LDA #0          ;BLACK
00115 486C  A2 28             LDX #40
00116 486E  9D 28 D8   COL4   STA CMST+40,X   ;SECOND TO TOP
00117 4871  9D C0 DB          STA CMST+960,X;AND LAST LINE
00118 4874  CA                DEX
00119 4875  D0 F7             BNE COL4
00120 4877             ;
00121 4877             ;
00122 4877  60                RTS
00123 4878             ;
00124 4878             ;===== DRAW IN SCREEN =====
00125 4878             ;
00126 4878  20         DATA   .BYT 32,32,32,2,2,2,2,32,32,32,2
 ,2,2,32,32,32,2,32,32
00126 487B  20
00126 487A  20
00126 487B  02
00126 487C  02
00126 487D  02
00126 487E  20
00126 487F  20
00126 4880  20
00126 4881  02
00126 4882  02
00126 4883  02
00126 4884  20
00126 4885  20
00126 4886  20
00126 4887  02
00126 4888  02
00126 4889  02
00126 488A  20
00126 488B  20
00127 488C  20         DATA1  .BYT 32,32,32,48,48,48,48,48,48,32
00127 488D  20
00127 488E  20
00127 488F  30
00127 1890  30
00127 4891  30
00127 4892  30
00127 4893  30
00127 4894  30
00127 4895  20
00128 4896             ;
00129 4896  A2 14      DRAW   LDX #20         ;20 BYTES
00130 4898  BD 78 48   DRAW1  LDA DATA,X       ;BUNKERS
00131 489B  9D 20 07          STA SCST+800,X
00132 489E  9D 34 07          STA SCST+820,X
00133 48A1  9D 48 07          STA SCST+840,X
00134 48A4  9D 5C 07          STA SCST+860,X
00135 48A7  9D 70 07          STA SCST+880,X
00136 48AA  9D 84 07          STA SCST+900,X
00137 48AD  CA                DEX
00138 48AE  D0 E8             BNE DRAW1
00139 48B0             ;
00140 48B0  A2 09             LDX #9          ;9 BYTES
00141 48B2  BD 8C 48   DRAW2  LDA DATA1,X      ;SCORE
00142 48B5  9D 00 04          STA SCST,X
00143 48B8  CA                DEX
00144 48B9  D0 F7             BNE DRAW2
00145 48BB  60                RTS
00146 48BC             ;
00147 48BC             ;
00148 48BC             ;===== DRAW BORDER =====
00149 48BC             ;
00150 48BC  A9 FF      BORD   LDA #$FF        ;PLOT=$D800,
00151 48BE  85 56             STA PLOT        ;THE START OF
00152 48C0  A9 03             LDA #$03        ;THE COLOUR
00153 48C2  85 57             STA PLOTT       ;SCREEN
00154 48C4  A0 01             LDY #1
00155 48C6  A2 17             LDX #23         ;23 LINES
00156 48C8             ;
00157 48C8  18         BORD1  CLC
00158 48C9  A5 56             LDA PLOT        ;PLOT=PLOT+40
00159 48CB  69 28             ADC #40
00160 48CD  85 56             STA PLOT
00161 48CF  A5 57             LDA PLOTT
00162 48D1  69 00             ADC #0
00163 48D3  85 57             STA PLOTT
00164 48D5             ;
00165 48D5  A9 17             LDA #23         ;MARKER
00166 48D7  91 56             STA (PLOT),Y;PUT COL ON LEFT
00167 48D9  CA                DEX             ;OF THE SCREEN
00168 48DA  D0 EC             BNE BORD1
00169 48DC  60                RTS
00170 48DD             ;
00171 48DD             ;
00172 48DD             ;
00173 48DD             ;===== DRAW INVADERS =====
00174 48DD             ;
00175 48DD  AD 0A 40   DRINV  LDA SHEET
00176 48E0  18                CLC
00177 48E1  6A                ROR A
00178 48E2  18                CLC
00179 48E3  6A                ROR A           ;DIVIDE BY 4
00179 48E4  AA                TAX             ;X=A
00180 48E5             ;
00181 48E5  A9 A0             LDA #160
00182 48E7  85 56             STA PLOT        ;PLOT=4 LINES
00183 48E9  A9 04             LDA #04         ;DOWN THE
00184 48EB  85 57             STA PLOTT       ;SCREEN
00185 48ED             ;
00186 48ED  8A         DRINV1 TXA             ;A=X
00187 48EE  F0 11             BEQ DRINV2
00188 48F0  18                CLC
00189 48F1  A5 56             LDA PLOT
00190 48F3  69 28             ADC #40         ;MOVE DOWN
00191 48F5  85 56             STA PLOT        ;1 LINE
00192 48F7  A5 57             LDA PLOTT
00193 48F9  69 00             ADC #0
00194 48FB  85 57             STA PLOTT
00195 48FD  CA                DEX
00196 48FE  4C ED 48          JMP DRINV1
00197 4901             ;
00198 4901             ;WHERE TO START PLOTTING THE INVADERS
00199 4901             ;IS NOW STORED IN PLOT & PLOTT
00200 4901             ;
00201 4901  A0 18      DRINV2 LDY #24         ;INVS PER LINE
00202 4903  A9 00      DRINV3 LDA #0
00203 4905  91 56             STA (PLOT),Y    ;LINE 1
00204 4907             ;
00205 4907  18                CLC
00206 4908  A5 56             LDA PLOT
00207 490A  69 28             ADC #40
00208 490C  85 58             STA PLOT2
00209 490E  A5 57             LDA PLOTT
00210 4910  69 00             ADC #0
00211 4912  85 59             STA PLOTT2
00212 4914  A9 01             LDA #1
00213 4916  91 58             STA (PLOT2),Y   ;LINE2
00214 4918             ;
00215 4918  18                CLC
00216 4919  A5 58             LDA PLOT2
00217 491B  69 28             ADC #40
00218 491D  85 58             STA PLOT2
00219 491F  A5 59             LDA PLOTT2
00220 4921  69 00             ADC #0
00221 4923  85 59             STA PLOTT2
00222 4925  A5 00             LDA #0
00223 4927  91 58             STA (PLOT2),Y   ;LINES
00224 4929             ;
00225 4929  18                CLC
00226 492A  A5 58             LDA PLOT2
00227 492C  69 28             ADC #40
00228 492E  85 58             STA PLOT2
00229 4930  A5 59             LDA PLOTT2
00230 4932  69 00             ADC #0
00231 4934  85 59             STA PLOTT2
00232 4936  A9 01             LDA #1
00233 4938  91 58             STA (PLOT2),Y   ;LINE4
00234 493A             ;
00235 493A  88                DEY             ;REPEAT FOR 12
00236 493B  88                DEY             ;INVS PER LINE
00237 493C  D0 C5             BNE DRINV3
00238 493E             ;
00239 493E             ;
00240 493E             ;===== MOVE ALL 0 INVS =====
00241 493E             ;
00242 493E  A5 50      INV    LDA #80
00243 1940  85 56             STA PLOT
00244 1942  A9 04             LDA #04
00245 4944  85 57             STA PLOTT       ;PLOT=TOP LEFT
00246 4946  A0 01             LDY #1
00247 4948  A9 3F             LDA #63         ;MARKER IN BOTTOM
00248 494A  8D BF 07          STA 1983        ;RIGHT
00249 494D             ;
00250 494D  18         INV1   CLC             ;
00251 494E  A5 56             LDA PLOT        ;WORK DOWN
00252 4950  69 01             ADC #1          ;THE SCREEN
00253 4952  85 56             STA PLOT        ;CHECKING
00254 4954  A5 57             LDA PLOTT       ;FOR 0'S
00255 4956  69 00             ADC #0
00256 4958  85 57             STA PLOTT
00257 495A  B1 56             LDA (PLOT),Y
00258 495C  F0 07             BEQ INV2        ;FOUND ONE
00259 495E  C9 3F             CMP #63
00260 4960  D0 EB             BNE INV1        ;FINISHED
00261 4962  4C A8 49          JMP IINV
00262 4965             ;
00263 4965  20 87 4B   INV2   JSR FORE
00264 4968  A0 01             LDY #1
00265 496A  A9 20             LDA #32         ;BLANK OUT
00266 496C  91 56             STA (PLOT),Y;INVADER
00267 496E             ;
00268 496E  A0 00             LDY #0
00269 4970  B1 56             LDA (PLOT),Y;WHERE TO GO
00270 4972             ;
00271 4972  C9 05             CMP #5          ;BULLET ?
00272 4974  D0 0B             BNE INV3
00273 4976  A0 01             LDY #1
00274 4978  20 22 4B          JSR BLEEP
00275 497B  20 A1 4B          JSR SCORE
00276 497E  4C 4D 49          JMP INV1
00277 4981             ;
00278 4981  C9 17      INV3   CMP #23         ;SIDE OF THE
00279 4983  D0 0B             BNE IJNV3       ;SCREEN
00280 4985  A9 01             LDA #1
00281 4987  A0 29             LDY #41
00282 4989  91 56             STA (PLOT),Y
00283 498B  A0 01             LDY #1
```

(listing 2 continued on next page)

(continued from previous page)

The only real problem left is scoring. As this has all been dealt with before, suffice to say that a simple counter is being used in the top left corner of the screen.

Although the program contains very few frills, it is still very long . . . do not forget to Save it before running it. The graphics have not actually been defined, but here are the character numbers and their use if you want to add your own.

Character number	Use
0	Invader (right to left)
1	Invader (left to right)
2	base defense (not hit)
3	base defence (hit once)
4	base defence (hit twice)
5	bullet going up
6	bullet going down
7	base ship
23	marker (should be blank)
32	space
48-58	numbers
63	marker (should be left blank)

The characters d, e and a should be defined for the word "Dead". Happy adapting and have fun with the graphics. ■

6502 MACHINE CODE MADE EASY

(listing 2 continued from previous page)

```
00284  49BD  4C 4D 49          JMP INV1
00285  49C0                 ;
00286  49C0  A9 00       IINV3  LDA #0
00287  49C2  91 56              STA (PLOT),Y
00288  49C4  A0 01              LDY #1
00289  49C6  4C 4D 49           JMP INV1
00290  49C9                 ;
00291  49C9  A9 20       INVA   LDA #32
00292  49CB  91 56              STA (PLOT),Y
00293  49D0  A0 29              LDY #41
00294  49CF  A9 01              LDA #1
00295  49A1  91 56              STA (PLOT),Y
00296  49A3  A0 01              LDY #1
00297  49A5  4C 4D 49           JMP INV1
00298  49A8                 ;
00299  49A8                 ;
00300  49A8                 ;===== MOVE ALL 1 INVADERS =====
00301  49A8                 ;
00302  49A8  A9 BF       IINV   LDA #$BF          ;ONE LINE UP
00303  49AA  85 56              STA PLOT
00304  49AC  A9 07              LDA #7
00305  49AE  85 57              STA PLOTT
00306  49B0  A0 00              LDY #0
00307  49B2  A9 3F              LDA #63          ;MARKER AT TOP
00308  49B4  8D 28 04           STA 1064         ;LEFT
00309  49B7                 ;
00310  49B7  38          IINV1  SEC
00311  49B8  A5 56              LDA PLOT         ;UP THE SCREEN
00312  49BA  E9 01              SBC #1           ;ONE SPACE AT
00313  49BC  85 56              STA PLOT         ;A TIME
00314  49BE  A5 57              LDA PLOTT
00315  49C0  E9 00              SBC #0
00316  49C2  85 57              STA PLOTT
00317  49C4  B1 56              LDA (PLOT),Y
00318  49C6  C9 01              CMP #1           ;INVADER RIGHT
00319  49C8  F0 09              BEQ IINV2
00320  49CA  C9 06              CMP #6           ;BULLET DOWN
00321  49CC  F0 59              BEQ IINV3
00322  49CE  C9 3F              CMP #63
00323  49D0  D0 E5              BNE IINV1
00324  49D2  60                 RTS
00325  49D3                 ;
00326  49D3                 ;
00327  49D3  20 B7 4B    IINV2  JSR FORE
00328  49D6  A0 00              LDY #0
00329  49D8  A9 20              LDA #32          ;BLANK OUT
00330  49DA  91 56              STA (PLOT),Y     ;INV.
00331  49DC  A0 01              LDY #1           ;WHERE TO GO
00332  49DE  B1 56              LDA (PLOT),Y
00333  49E0  C9 05              CMP #5           ;BULLET ?
00334  49E2  D0 0F              BNE IINV4
00335  49E4  A9 20              LDA #32
00336  49E6  91 56              STA (PLOT),Y
00337  49E8  A0 00              LDY #0
00338  49EA  20 22 4B           JSR BLEEP
00339  49ED  20 A1 4B           JSR SCORE
00340  49F0  4C B7 49           JMP IINV1
00341  49F3                 ;
00342  49F3  C9 3F       IINV4  CMP #63          ;HAVE THEY
00343  49F5  D0 06              BNE IINV5        ;LANDED ?
00344  49F7  A9 01              LDA #1
00345  49F9  8D 09 40           STA DIED
00346  49FC  60                 RTS
00347  49FD                 ;
00348  49FD  C9 17       IINV5  CMP #23          ;EDGE
00349  49FF  D0 0B              BNE IJNV5
00350  4A01  A9 00              LDA #0
00351  4A03  A0 27              LDY #39
00352  4A05  91 56              STA (PLOT),Y
00353  4A07  A0 00              LDY #0
00354  4A09  4C B7 49           JMP IINV1
00355  4A0C
00356  4A0C  A9 01       IJNV5  LDA #1
00357  4A0E  91 56              STA (PLOT),Y
00358  4A10  A0 00              LDY #0
00359  4A12  4C B7 49           JMP IINV1
00360  4A15                 ;
00361  4A15  A9 20       IINV6  LDA #32          ;EDGE
00362  4A17  91 56              STA (PLOT),Y     ;BLANK OUT
00363  4A19  A0 28              LDY #40          ;INV,CHANGE
00364  4A1B  A9 00              LDA #0           ;DIRECTION
00365  4A1D  91 56              STA (PLOT),Y     ;REPLOT IT
00366  4A1F  A0 00              LDY #0
00367  4A21  20 22 4B           JSR BLP          ;BLEEP
00368  4A24  4C B7 49           JMP IINV1        ;NEXT PLEASE
00369  4A27                 ;
00370  4A27  A9 20       IINV3  LDA #32
00371  4A29  91 56              STA (PLOT),Y
00372  4A2B  A0 28              LDY #40          ;ONE LINE
00373  4A2D  B1 56              LDA (PLOT),Y     ;DOWN
00374  4A2F  C9 02              CMP #2           ;BUNKER ?
00375  4A31  D0 09              BNE IINV7
00376  4A33  A9 03              LDA #3           ;DECOMPOSE
00377  4A35  91 56              STA (PLOT),Y     ;IT
00378  4A37  A0 00              LDY #0
00379  4A39  4C B7 49           JMP IINV1
00380  4A3C
00381  4A3C  C9 03       IINV7  CMP #3           ;BUNKER
00382  4A3E  D0 09              BNE IINV8
00383  4A40  A9 04              LDA #4
00384  4A42  91 56              STA (PLOT),Y
00385  4A44  A0 00              LDY #0
00386  4A46  4C B7 49           JMP IINV1
00387  4A49                 ;
00388  4A49  C9 04       IINV8  CMP #4
00389  4A4B  D0 09              BNE IINV9
00390  4A4D  A9 20              LDA #32
00391  4A4F  91 56              STA (PLOT),Y
00392  4A51  A0 00              LDY #0
00393  4A53  4C B7 45           JMP IINV1
00394  4A56                 ;
00395  4A56  C9 07       IINV9  CMP #7
00396  4A58  D0 06              BNE IINVR
00397  4A5A  A9 01              LDA #1
00398  4A5C  8D 09 40           STA DIED
00399  4A5F  60                 RTS
00400  4A60                 ;
00401  4A60  A9 06       IINVR  LDA #6
00402  4A62  91 56              STA (PLOT),Y
00403  4A64  A0 00              LDY #0
00404  4A66  4C B7 49           JMP IINV1
00405  4A69                 ;
00406  4A69                 ;
00407  4A69                 ;===== MOVE THE BULLET UP =====
00408  4A69                 ;
00409  4A69  A0 00       BUL    LDY #0           ;HAS THE
00410  4A6B  B1 5A              LDA (BUL1),Y;BULLET BEEN
00411  4A6D  C9 05              CMP #5           ;HIT ?
00412  4A6F  F0 06              BEQ BULS         ;NO
00413  4A71  A9 01              LDA #1           ;SET
00414  4A73  8D 06 40           STA FLAG         ;FIRE FLAG
00415  4A76  60                 RTS
00416  4A77
00417  4A77  A9 20       BUL3   LDA #32
00418  4A79  91 5A              STA (BUL1),Y
00419  4A7B  38                 SEC
00420  4A7C  A5 5A              LDA BUL1         ;MOVE BULLET
00421  4A7E  E9 28              SBC #40          ;UP
00422  4A80  85 5A              STA BUL1
00423  4A82  A5 5B              LDA BUL2
00424  4A84  E9 00              SBC #0
00425  4A86  85 5B              STA BUL2
00426  4A88
00427  4A89  18                 CLC              ;TOP OF
00428  4A89  A5 5B              LDA BUL2         ;SCREEN
00429  4A8B  69 D4              ADC #$D4         ;IS BLACK
00430  4A8D  85 59              STA PLOTT2       ;IF SO
00431  4A8F  A5 5A              LDA BUL1         ;THEN
00432  4A91  85 58              STA PLOTZ        ;RETURN
00433  4A93  B1 58              LDA (PLOT2),Y
00434  4A95  D0 01              BNE BUL4
00435  4A97  60                 RTS
00436  4A98
00437  4A98  B1 5A       BUL4   LDA (BUL1),Y     ;WHATS
00438  4A9A  C9 20              CMP #32          ;THERE
00439  4A9C  F0 08              BEQ BUL5
00440  4A9E  20 22 4B           JSR BLEEP
00441  4AA1  20 A1 4B           JSR SCORE
00442  4AA4  A9 20              LDA #32          ;REPLOT
00443  4AA6  91 5A              STA (BUL1),Y
00444  4AA8  60                 RTS
00445  4AA9
00446  4AA9  A9 05       BUL5   LDA #5
00447  4AAB  91 5A              STA (BUL1),Y
00448  4AAD  60                 RTS
00449  4AAE
00450  4AAE
00451  4AAE                 ;===== MOVE THE BASE =====
00452  4AAE
00453  4AAE  A9 20       BASE   LDA #32
00454  4AB0  AE 08 40          LDX POS
00455  4AB3  9D 98 07           STA 1024+920,X
00456  4AB6
00457  4AB6  20 E4 FF           JSR $FFE4        ;CHECK KEYBOARD
00458  4AB9  D0 01              BNE BASE1        ;KEY PUSHED
00459  4ABB  60                 RTS              ;NOT PRESSED
00460  4ABC
00461  4ABC  C9 5A       BASE1  CMP #90
00462  4ABE  F0 09              BEQ BASE2        ; "Z"  -LEFT
00463  4AC0  C9 2F              CMP #47
00464  4AC2  F0 13              BEQ BASE3        ; "/"  -RIGHT
00465  4AC4  C9 20              CMP #32
00466  4AC6  F0 1D              BEQ BASE4        ;SPACE -FIRE
00467  4AC8  60                 RTS
00468  4AC9
00469  4AC9  AD 08 40    BASE2  LDA POS          ;BASE POS'N
00470  4ACC  C9 01              CMP #1           ;ALREADY LEFT
00471  4ACE  D0 01              BNE BASE2A       ;NO
00472  4AD0  60                 RTS
00473  4AD1
00474  4AD1  CE 08 40    BASE2A DEC POS          ;POS=POS-1
00475  4AD4  4C 24 4B           JMP BPLOT        ;PLOT BASE
00476  4AD7
00477  4AD7  AD 08 40    BASE3  LDA POS
00478  4ADA  C9 26              CMP #38          ;RIGHT?
00479  4ADC  D0 01              BNE BASE3A       ;NO
00480  4ADE  60                 RTS
00481  4ADF
00482  4ADF  EE 08 40    BASE3A INC POS          ;POS=POS+1
00483  4AE2  4C 24 4B           JMP BPLOT
00484  4AE5
00485  4AE5  AD 06 40    BASE4  LDA FLAG
00486  4AE8  D0 01              BNE BASE4A       ;CAN FIRE
00487  4AEA  60                 RTS
00488  4AEB
00489  4AEB  18         BASE4A CLC
00490  4AEC  A9 98              LDA #$98         ;BUL
00491  4AEE  6D 08 40           ADC POS          ;=
00492  4AF1  85 5A              STA BUL1         ;POS+LINE
00493  4AF3  A9 07              LDA #07          ;POSITION
00494  4AF5  69 00              ADC #0
00495  4AF7  85 5B              STA BUL2
00496  4AF9  A9 00              LDA #0
00497  4AFB  8D 06 40           STA FLAG
00498  4AFE  A9 05              LDA #5           ;PLOT BULLET
00499  4B00  A0 00              LDY #0
00500  4B02  91 5A              STA (BUL1),Y
00501  4B04  60                 RTS
00502  4B05
00503  4B05
00504  4B05                 ;====== DELAY =====
00505  4B05
00506  4B05  8D 00 40    DELAY  STA TEMPA        ;SAVE REGISTERS
00507  4B08  8E 01 40           STX TEMPX
00508  4B0B  8C 02 40           STY TEMPY
00509  4B0E
00510  4B0E  A2 80              LDX #128         ;DELAY SUB.
00511  4B10  A0 00       DELAY1 LDY #128
00512  4B12  88         DELAY2 DEY
00513  4B13  D0 FD              BNE DELAY2
00514  4B15
00515  4B16  D0 F8              BNE DELAY1
00516  4B18
00517  4B18  AD 00 40           LDA TEMPA;RE-LOAD REGISTERS
00518  4B1B  AC 02 40           LDY TEMPY
00519  4B1E  AE 01 40           LDX TEMPX
00520  4B21
00521  4B21  60         BLEP   RTS              ;THE SOUND IS FOR YOU
00522  4B22  60         BLEEP  RTS              ;TO TRY(ADD ONE OF
00523  4B23  60         BLP    RTS ;THE ROUTINES USED EARLIER
00524  4B24
00525  4B24                 ;===== PLOT THE BASE =====
00526  4B24
00527  4B24  AE 08 40  BPLOT  LDX POS
00528  4B27  A9 07              LDA #7
00529  4B29  9D 98 07           STA 1024+920,X
00530  4B2C  60                 RTS
00531  4B2D
00532  4B2D
00533  4B2D                 ;===== DEAD =====
00534  4B2D
00535  4B2D                 ;HERES THE PLACE TO PUT A TUNE
00536  4B2D                 ;(QV. DEATHMARCH) IF YOU WANT TO
00537  4B2D
00538  4B2D  A9 04       DEAD   LDA #4
00539  4B2F  8D 0A 04           STA 1024+10
00540  4B32  8D 0D 04           STA 1024+13
00541  4B35  A9 05              LDA #5
00542  4B37  8D 0B 04           STA 1024+11
00543  4B3A  A9 01              LDA #1
00544  4B3C  8D 0C 04           STA 1024+12
00545  4B3F
00546  4B3F  A5 56       DEAD1  LDA PLOT
00547  4B41  8D 20 D0           STA 53200
00548  4B44  A5 57              LDA PLOTT
00549  4B46  8D 21 D0           STA 53281
00550  4B49  E6 56              INC PLOT
00551  4B4B  E6 57              INC PLOTT
00552  4B4D  20 05 4B           JSR DELAY
00553  4B50  20 E4 FF           JSR $FFE4
00554  4B53  F0 EA              BEQ DEAD1
00555  4B55
00556  4B55  4C 00 48           JMP MAIN
00557  4B58
00558  4B58
00559  4B58                 ;===== ARE ALL INVS GONE =====
00560  4B58
00561  4B58  A9 2A       OVER   LDA #42
00562  4B5A  85 56              STA PLOT
00563  4B5C  A9 04              LDA #4
00564  4B5E  85 57              STA PLOTT
00565  4B60  A0 00              LDY #0
00566  4B62  8C 07 40           STY FLAG2
00567  4B65
00568  4B65  18         OVER1  CLC
00569  4B66  A5 56              LDA PLOT
00570  4B68  69 01              ADC #1
00571  4B6A  85 56              STA PLOT
00572  4B6C  A5 57              LDA PLOTT
00573  4B6E  69 00              ADC #0
00574  4B70  85 57              STA PLOTT
00575  4B72  B1 56              LDA (PLOT),Y
00576  4B74  C9 01              CMP #1
00577  4B76  F0 0E              BEQ OVER2
00578  4B78  C9 00              CMP #0
00579  4B7A  F0 0A              BEQ OVER2
00580  4B7C  C9 3F              CMP #63
00581  4B7E  D0 E5              BNE OVER1
00582  4B80  EE 0A 40           INC SMEET
00583  4B83  4C 00 48           JMP MAIN
00584  4B86
00585  4B86  60         OVER2  RTS
00586  4B87
00587  4B87
00588  4B87                 ;===== INVADER FIRE =====
00589  4B87
00590  4B87  AD 12 D0    FORE   LDA RAND         ;RANDOM NUMBER
00591  4B8A  C9 FA              CMP #250         ;FIRE RATE
00592  4B8C  B0 01              BCS FORE1
00593  4B8E  60                 RTS
00594  4B8F
00595  4B8F  A0 28       FORE1  LDY #40
00596  4B91  B1 56              LDA (PLOT),Y
00597  4B93  C9 20              CMP #32
00598  4B95  F0 03              BEQ FORE2
00599  4B97  A0 00              LDY #0
00600  4B99  60                 RTS
00601  4B9A
00602  4B9A  A9 06       FORE2  LDA #6
00603  4B9C  91 56              STA (PLOT),Y
00604  4B9E  A0 00              LDY #0
00605  4BA0  60                 RTS
00606  4BA1
00607  4BA1
00608  4BA1                 ;===== SCORE ROUTINE =====
00609  4BA1
00610  4BA1  F8         SCORE  SED
00611  4BA2  18                 CLC
00612  4BA3  AD 03 40           LDA SCOR6        ;ADD 1 TO THE
00613  4BA6  69 01              ADC #1           ;SCORE
00614  4BA8  8D 03 40           STA SCOR6
00615  4BAB  AD 04 40           LDA SCOR5        ;CHECK FOR THE
00616  4BAE  69 00              ADC #0           ;CARRY BIT
00617  4BB0  8D 04 40           STA SCOR5
00618  4BB3  AD 05 40           LDA SCOR4        ;AND AGAIN
00619  4BB6  69 00              ADC #0
00620  4BB8  8D 05 40           STA SCOR4
00621  4BBB  D8                 CLD
00622  4BBC
00623  4BBC                 ;THE SCORE HAS NOW BEEN INCREMENTED
00624  4BBC                 ;NOW DISPLAY IT
00625  4BBC
00626  4BBC  AD 03 40           LDA SCOR6
00627  4BBF  6A                 ROR A            ;BLANK OUT LEAST SIG. NIBBL
00628  4BC0  6A                 ROR A
00629  4BC1  6A                 ROR A
00630  4BC2  6A                 ROR A
00631  4BC3  18                 CLC
00632  4BC4  69 30              ADC #48          ;CONVERT TO ASCII
00633  4BC6  8D 09 04           STA SCST+9
00634  4BC9  AD 03 40           LDA SCOR6        ;GET LEAST SIG. NIBBLE
00635  4BCC  29 0F              AND #15
00636  4BCE  69 30              ADC #48          ;CARRY BIT MUST BE 0
00637  4BD0  8D 08 04           STA SCST+8
00638  4BD3
00639  4BD3  AD 04 40           LDA SCOR5
00640  4BD6  6A                 ROR A
00641  4BD7  6A                 ROR A
00642  4BD8  6A                 ROR A
00643  4BD9  6A                 ROR A
00644  4BDA  18                 CLC
00645  4BDB  69 30              ADC #48
00646  4BDD  8D 07 04           STA SCST+7
00647  4BE0  AD 04 40           LDA SCOR5
00648  4BE3  29 0F              AND #15
00649  4BE5  69 30              ADC #48
00650  4BE7  8D 06 04           STA SCST+6
00651  4BEA
00652  4BEA  AD 05 40           LDA SCOR4        ;REPEAT FOR
00653  4BED  6A                 ROR A            ;THE OTHER
00654  4BEE  6A                 ROR A            ;DIGITS
00655  4BEF  6A                 ROR A
00656  4BF0  6A                 ROR A
00657  4BF1  18                 CLC
00658  4BF2  69 30              ADC #48
00659  4BF4  8D 05 04           STA SCST+5
00660  4BF7  AD 05 40           LDA SCOR4
00661  4BFA  29 0F              AND #15
00662  4BFC  69 30              ADC #48
00663  4BFE  8D 04 04           STA SCST+4
00664  4C01
00665  4C01                 ;THE SCORE IS NOW ON THE SCREEN
00666  4C01
00667  4C01  60                 RTS
00668  4C02
00669  4C02                 ;===== RESET SCORE ,FLAGS ETC =====
00670  4C02
00671  4C02  A9 00       RESET  LDA #0
00672  4C04  8D 03 40           STA SCOR6        ;SCOR = 0
00673  4C07  8D 04 40           STA SCOR5
00674  4C0A  8D 05 40           STA SCOR4
00675  4C0D  8D 03 40           STA DIED         ;ALIVE AGAIN
00676  4C10  8D 06 40           STA FLAG
00677  4C13  8D 07 40           STA FLAG2        ;CAN FIRE
00678  4C16  8D 21 D0           STA 53281        ;BLACK ON
00679  4C19  8D 20 D0           STA 53200        ;BLACK
00680  4C1C  A9 0C              LDA #12
00681  4C1E  8D 08 40           STA POS          ;MIDDLE OF SCREEN
00682  4C21  60                 RTS
00683  4C22
00684  4C22
00685  4C22
00686  4C22                     .END
```

"robustness and reliability were excellent... a really good feel to the action... a pleasure to use... not one game failed to load... nice professional ... I like it... very impressed"

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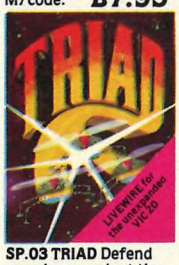

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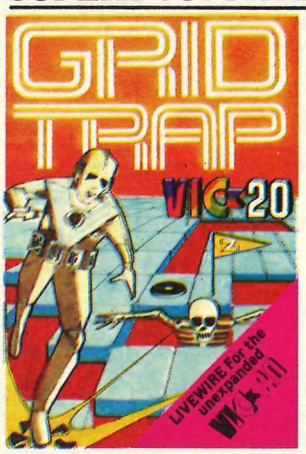

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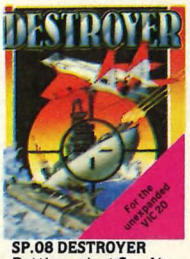

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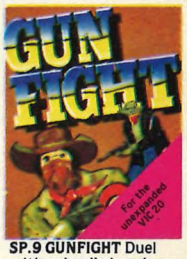

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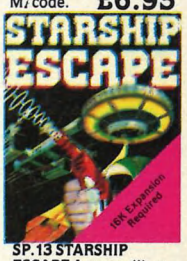

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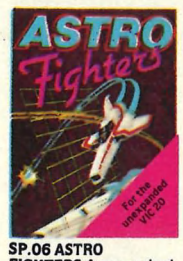

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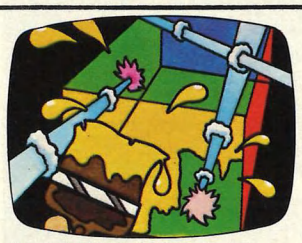

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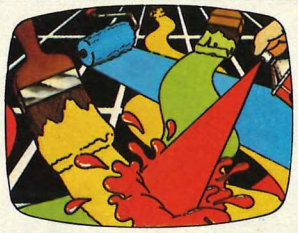

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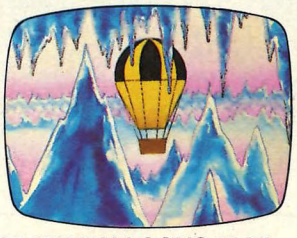

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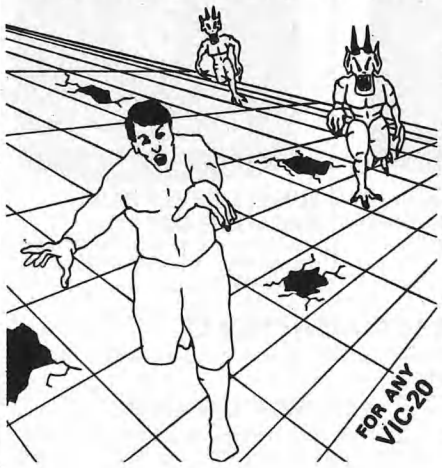

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RESPONSE FRAME

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GUARANTEE

■ Last November I purchased a 16K Spectrum. I found this very useful but as I progressed I found that the 9K RAM available to the user was insufficient for larger programs and databases. I have seen various advertisements for upgrades to 48K for far less than the £60 Sinclair upgrade. I have been led to believe that installation of such an upgrade requires the machine to be taken apart. Does this void the Sinclair guarantee, and if so, do the companies selling such upgrades offer their own guarantee? Are the upgrades easy to fit or do you have to send in your Spectrum for fitting?

P Crawley,
Bucknell, Salop.

AS FAR AS I can determine, only one company — Kempstone — claims its memory upgrade will not void the guarantee. You are right in saying the machine must be taken apart to fit the unit. The vast majority of companies selling the upgrade units provide a fitting service. Functionally, there is no difference between a Sinclair memory upgrade, and a non-Sinclair one. You may well find that the Microdrive is more use to you for database programs and may therefore prefer to save your money for the drive.

A GOOD BUY

■ I wish to buy a computer for around £400 or less which will be used predominately for word-processing. Which one is the best to get?

Vince Gifford,
Hastings, East Sussex.

THERE ARE several computers in the price range you mention which provide you with serviceable word-processing capabilities. The main things to look for are a "proper" keyboard, that is, one which is like a typewriter keyboard and a word-processing program for that machine. Both these pretty obvious conditions must be met. There are several computers which have word processor programs available, but have keyboards which do not sustain long term typing and could not support touch typing. As well, if you are interested in writing long sections of text — as opposed to just two and three page letters — you will need text storage and for practical use, this should be on disk. However, adding disks will move the cost of the computer out of the range you specify. The BBC Micro is one machine you should consider. Both the BBC's word processing programs View and Wordwise are available in ROM — View is £52, Wordwise is £34.50! Having a program in ROM means it is always available, simply by typing in a command. Gemini Marketing, 03952-5832, is one of many other companies which provides a word processing package for the BBC Micro. Its program, which is designed primarily for letter-writing, is £19.95. The Dragon is also worth considering, as it has a fairly good keyboard. The Vic-20 has a good keyboard, a choice of several word processing programs, but its coarse screen — 23 characters across — is seen by many as a disadvantage for word processing.

NO POINT

■ Could you please explain why the Point instruction does not work while using Print statements on our BBC Micro Model B with 1.2 operating system and did not work when we had the 0.1 OS either? I find this problem irritating as I feel there is probably some way of making it work.

Colin MacDonald,
Bothwell, Glasgow.

THE ONLY reason I can imagine for it not appearing to work is that you are trying to use it in mode 7 — it only works in modes 0 to 6 — and that you are trying to get it to work with Print Tab co-ordinates. Point co-ordinates start in the bottom left hand corner of the screen. The grid is from 0 to 1023 and from 0 to 1279.

ZX-81 KEYBOARD

■ I am a ZX-81 owner. I am considering purchasing a full-size keyboard for my machine. I would like this keyboard to have repeat facilities and possibly single-key Edit, Function, Rubout and the like. The choice on the market is bewildering. However, the keyboard I am most interested in, from Harris and Lockyer Associates, will not fit the ZX-81 PCB inside. This is annoying because if I am going to buy other add-ons which fit on the edge connector — my ZX-81 is tilted at an angle to let the heat out — the weight of them, as they are not resting on the table, will probably either break them or cause a whiteout when they wobble. What keyboard should I buy?

David Wilding,
London, N16.

THE CHOICE problem has been compounded by your decision to have the computer at an angle. I use an extension keyboard on a desk. Above the desk is a small shelf which is not connected to the desk. The ZX-81, RAMpack and the rest, sit on this shelf. The ZX-81 is raised slightly off the shelf, held at the edges, to allow heat to escape. However, it is not tilted, but stands parallel to the shelf. I have a large bulldog clip holding the cable onto the edge of the shelf between the computer and the keyboard. This means that even if I knock the keyboard, this is not transmitted to the computer. There are several suitable keyboards on the market, any of which should serve you well. Certainly, we have not heard about recurrent problems with any brand. Simplify your choice by realising you do not have the ZX-81 on an angle.

ANIMATION

■ I own a 16K ZX Spectrum which I have found is not very good for some kinds of high-resolution animated graphics. The BBC's VDU 19 command seems to help here. I was wondering if there was any routine which I could use to emulate this?

Alan Thompson,
Asham, Penrith.

I DO NOT know of any 'pre-potted' routine to carry out VDU 19's function. You can easily change the whole background colour of the Spectrum screen without disturbing what is on it, by declaring an array 704 characters long, thus:

DIM A$(704)),

then printing this At 0, 0 prefaced by Over 1. Putting graphics within strings, and then manipulating them by string-slicing is the simplest and, in many cases, the fastest way to get moving graphics on the Spectrum in Basic. If you wish to progress into machine code, and create your own VDU 19, there are a number of books which could help you, including *Machine Language Made Simple on the Spectrum* by Tang, *Mastering Machine Code on the ZX Spectrum* by Baker, and *Spectrum Machine Code Made Easy,* books one and two, Holmes and Walsh.

LYNX QUERY

■ As a present ZX-81 owner, I am contemplating upgrading to a more advanced machine. The computer I have in mind is the Lynx but I have one grave misgiving about the machine — it only handles single statement lines. My question is: can the machine be made to handle multi-statement lines easily? Apart from this query, the Lynx seems to suit my requirements admirably, so I will wait for an answer from you before I go out and buy my Lynx.

R Drain,
Saltash, Cornwall.

THE LYNX is not provided with multi-statement lines. However, it does accept lines with decimal points, so 10.453 is a valid line number, which should allow you to insert as many lines as you like in a program. Multi-statement lines cannot be easily emulated on the Lynx. Having more than one statement to a line number is not considered very good programming practice in some circles, as it can lead to listings which are very hard to read and to debug. One time when they are very useful is when you want the computer to evaluate an If-Then statement, and to carry out, or jump, a series of instructions depending on the outcome of the evaluation. You can get round this, as I am sure you have learnt to do, on the ZX-81 by using the If-Then to jump a section of unwanted code. You may well find that other features provided by the Lynx will compensate for the lack of multi-statement lines.

I WANT ARRAYS

■ Your review of the Computer Lynx stressed the potential of this machine for expansion and its CP/M compatibility. In another part of the magazine, it was mentioned that the Lynx was weak on string handling and could not use string arrays. The review mentions CP/M as handling files of data which presumably implies some form of array in use. Does this mean that the Lynx has to expand to CP/M before file handling is possible or is the string restriction caused by the Basic used? If so, would Forth or Pascal provide arrays?

T Asquith,
Newport, Shropshire.

YOU SEEM to have confused a couple of points. The Lynx, when first issued, did not provide string arrays, but the reaction to this was so negative, the Basic was modified. String handling is a quite different issue from CP/M. CP/M stands for Control Program/Microcomputer, a very widely used disc-operating system developed and marketed by Digital Research, Pacific Grove, California. A large quantity of public domain software is available to run on CP/M machines.

DO NOT CHANGE

■ I recently purchased by mail order the 'Book of Listings' for my BBC Model B Micro. I was somewhat disappointed to discover the book is written for the operating system 0.1 having recently had my micro fitted with the 1.2. Please could you advise which of the listings in the book will not run on the 1.2, and if possible, any changes to adapt those listings?

Nigel Hunt,
Bagshot, Surrey.

ALL PROGRAMS in the book will work on the 1.2 OS. ■

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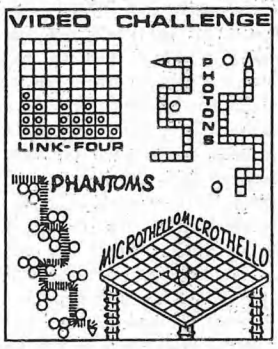

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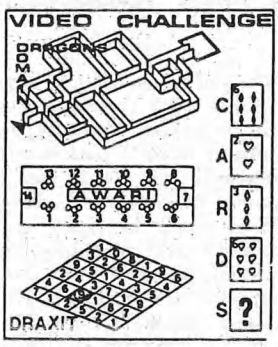

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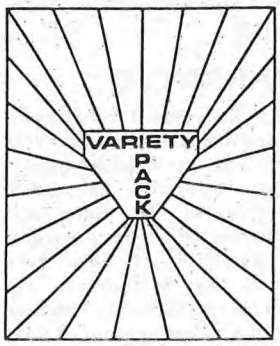

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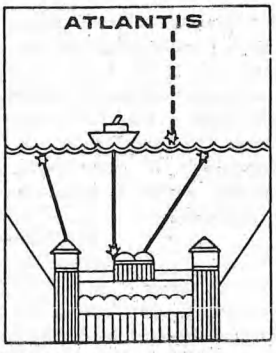

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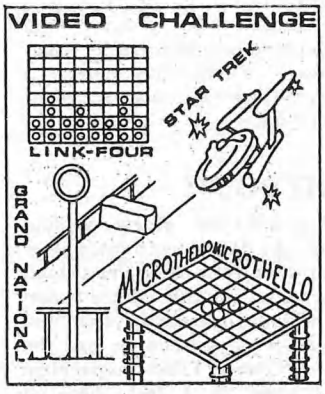

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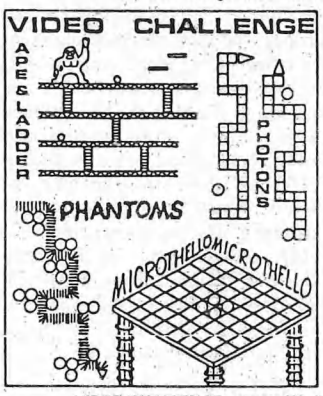

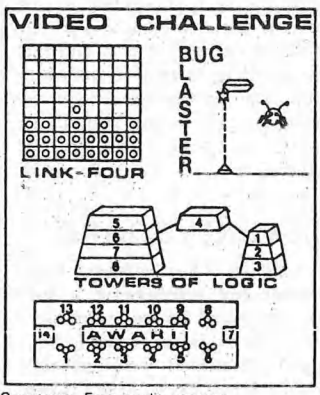

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Tubewars

J Bull,
Dursley,
Gloucestershire.

SPECTRUM

THE GAME TUBEWARS runs on either the 16K or 48K ZX Spectrum. The game is based on the arcade game Tempest. Although it is written entirely in Basic it is still fast enough to be enjoyable. Instructions are included in the listing but a couple of points should be stressed. When an electron finishes its run by reaching the rim of the tube a magenta cannon is drawn up, indicating that portion of the rim is electrified. If your cannon runs over this section it is destroyed. Your cannon is also destroyed if it is in the path of an enemy when it finishes its run; by reaching the tube rim the level number is the number of enemy that have to reach the rim before the game ends. That is if your cannon is not destroyed before

```
  5 GO TO 8000
 10 GO TO 5000
 30 PLOT 96,152: DRAW 36 12: DR
AW 36,-12: RETURN
 31 PLOT 168,152: DRAW 40 0: DR
AW 8 -24: RETURN
 32 PLOT 216,127: DRAW 12 -20
DRAW -12,-20: RETURN
 33 PLOT 168,63: DRAW 40 0: DRA
W 8,24: RETURN
 34 PLOT 96,63: DRAW 36 -12: DR
AW 36,12: RETURN
 35 PLOT 95,63: DRAW -40 0: DRA
W -8,24: RETURN
 36 PLOT 47,127: DRAW -12 -20
DRAW 12,-20: RETURN
 37 PLOT 95,152: DRAW -40,0: DR
AW -8 -24: RETURN
 40 LET x=16: LET y=6: LET dy=-
.5: LET dx=0: RETURN
 41 LET x=17: LET y=7: LET dy=-
.5: LET dx=1: RETURN
 42 LET x=19: LET y=8: LET dy=0
: LET dx=1: RETURN
 43 LET x=17: LET y=8.5: LET dy
=.5: LET dx=1: RETURN
 44 LET x=16: LET y=9.5: LET dy
=.5: LET dx=0: RETURN
 45 LET x=15: LET y=8.5: LET dy
=.5: LET dx=-1: RETURN
 46 LET x=13: LET y=8: LET dy=0
: LET dx=-1: RETURN
 47 LET x=15: LET y=7: LET dy=-
.5: LET dx=-1: RETURN
 60 OVER 0: INK 5: GO SUB 199+p
: BEEP .005,10: BEEP .005,20: IN
K 2: GO SUB 199+p: OVER 1
 80 IF c=p THEN LET sc=sc+100:
PRINT AT y1,x1;a$(c1): GO SUB 11
0
 90 IF d=p THEN LET sc=sc+75: P
RINT AT y2,x2;b$(c2): GO SUB 130
 95 RETURN
100 GO SUB 29+k: LET k=c: INK 3
: GO SUB 29+k: INK 2: IF p=c THE
N GO TO 7000
110 LET c=INT (RND*8)+1: GO SUB
39+c: LET x1=x: LET y1=y: LET d
x1=dx: LET dy1=dy: LET c1=1: RET
URN
120 IF p=d THEN GO TO 7000
130 LET d=INT (RND*8)+1: GO SUB
39+d: LET x2=x: LET y2=y: LET d
x2=dx: LET dy2=dy: LET c2=1: RET
URN
200 PLOT 95,152: DRAW 32 -32: P
LOT 168,152: DRAW -32,-32: RETUR
N
201 PLOT 168,152: DRAW -32 -32:
PLOT 215,128: DRAW -64,-16: RET
URN
202 PLOT 215,128: DRAW -64,-16:
PLOT 214,88: DRAW -64,16: RETUR
N
203 PLOT 214,88: DRAW -64,16: P
LOT 167,64: DRAW -32,32: RETURN
204 PLOT 167,64: DRAW -32,32: P
LOT 96,64: DRAW 32,32: RETURN
205 PLOT 95,63: DRAW 32,32: PLO
T 49,88: DRAW 64,16: RETURN
206 PLOT 49,88: DRAW 64,16: PLO
T 48,128: DRAW 64,-16: RETURN
207 PLOT 48,128: DRAW 64,-16: P
LOT 95,152: DRAW 32,-32: RETURN
209 RETURN
1010 GO SUB 29+p
1020 LET p=p+(INKEY$="x")-(INKEY
$="z"): LET p=p+(p=0)*8-(p=9)*8
1030 INK 6: GO SUB 29+p: INK 2
1040 IF INKEY$=" " THEN GO SUB 6
0
1100 PRINT AT y1,x1;a$(c1): LET
y1=y1+dy1: LET x1=x1+dx1: LET c1
=c1+1: IF c1=9 THEN LET r=r+1: G
O SUB 100
1110 PRINT INK 4;AT y1,x1;a$(c1)
1120 PRINT AT y2,x2;b$(c2): LET
y2=y2+dy2: LET x2=x2+dx2: LET c2
=c2+1: IF c2=9 THEN LET r=r+1: G
O SUB 120
1130 PRINT INK 3;AT y2,x2;b$(c2)
1200 IF k=p THEN GO TO 7000
1210 IF r=l THEN PRINT AT 21,3;
"All Enemy Have Reached Rim": GO
TO 7000
1500 GO TO 1000
5000 INK 2: BRIGHT 1: PAPER 0: C
LS : BORDER 0: CLS
5010 PRINT INK 6;AT 0,12;"TUBEWA
R": INK 4;AT 1,12;"━━━━━━━━━━": INK
2;AT 18,9;"© 1983 J.Bull"
5015 REM graphics D
5020 PRINT INK 4;AT 3,0;"D -Elec
tron      100 Points      Elec
trifies Rim When Reached    Do N
ot Touch Electrified Rim"
5025 REM graphics G
5030 PRINT INK 3;AT 7,0;"G -Guar
d      75 Points"
5040 PRINT INK 5;AT 9,0;"  'X'
 Rotate Clockwise"
5050 PRINT INK 4;AT 10,0;"  'Z'
 Rotate Anticlockwise"
5060 PRINT INK 3;AT 11,0;"'SPACE
' Fires Cannon"
5070 PRINT INK 6;AT 13,0;"LEVEL
is Number of Enemy That  Have t
o Reach Rim Before End"
5080 PRINT INK 4;AT 16,0;"Select
LEVEL  1  2  3  4"
5090 LET v$=INKEY$: IF CODE v$>4
8 AND CODE v$<53 THEN LET l=(VAL
v$)*10: GO TO 5110
5100 GO TO 5090
5110 CLS
5130 PRINT INK 6;AT 16,13;"TUBEW
AR": INK 4;AT 17,13;"━━━━━━━━━━"
6000 OVER 0
6010 PLOT 96,152: DRAW 72,0: DRA
W 32,-8: DRAW 16,-16: DRAW 0,-41
: DRAW -16,-16: DRAW -32,-8
6020 DRAW -73,0: DRAW -32,8: DRA
W -16,16: DRAW 0,40: DRAW 16,16:
DRAW 32,8
6030 PLOT 128,119: DRAW 7,0: DRA
W 16,-8: DRAW 0,-7: DRAW -16,-8:
DRAW -7,0: DRAW -16,8: DRAW 0,7
: DRAW 16,8
6040 PLOT 96,151: DRAW 32,-32: D
RAW 7,0: DRAW 32,32
6050 PLOT 215,128: DRAW -64,-16:
DRAW 0,-8: DRAW 64,-16
6060 PLOT 96,64: DRAW 32,32: DRA
W 7,0: DRAW 32,-32
6070 PLOT 48,128: DRAW 64,-16: D
RAW 0,-8: DRAW -64,-16
6200 GO SUB 110: GO SUB 130
6205 OVER 1
6207 REM graphics A
6210 PRINT AT y1,x1;"A";AT y2,x2
;"A"
6215 REM graphics A,B etc
6220 LET a$="AABBCCDD": LET b$="
AAEEFFGG"
6230 LET p=1: GO SUB 30: LET k=9
6240 LET sc=0: LET r=0
6300 GO TO 1000
7000 OVER 0: FOR a=1 TO 5: FOR b
=6 TO 0 STEP -1: INK b: GO SUB 2
9+p: BEEP .01,b: NEXT b: BEEP .0
1,a: BEEP .01,a+2: BEEP .01,a+4:
NEXT a
7010 INK 5: PRINT AT 0,11;"<< SC
ORE >>": AT 1,14;sc
7020 PRINT AT 19,1;"Press 'P' to
 Play,  'S' to Stop "
7030 IF INKEY$="p" OR INKEY$="P"
THEN RUN 10
7040 IF INKEY$="s" OR INKEY$="S"
THEN STOP
7050 GO TO 7030
8000 DATA 0,0,0,8,0,0,0,0
8010 DATA 0,0,8,20,8,0,0,0
8020 DATA 0,8,20,34,20,8,0,0
8030 DATA 8,20,34,65,34,20,8,0
8040 DATA 0,0,20,8,20,0,0,0
8050 DATA 0,34,20,8,20,34,0,0
8060 DATA 65,34,20,8,20,34,65,0
8100 FOR a=0 TO 55: READ b: POKE
USR "a"+a,b: NEXT a
8120 RUN 10
```

Intelligent animal

C A Wilson,
Netherthang,
Huddersfield.

ZX-81

ARTIFICIAL INTELLIGENCE sounds fascinating, but is rarely claimed for the ZX-81. The most common form of AI, an animal-guessing game can be found in many books, written for most computers. However, studying a listing with a view to adapting it to the ZX-81 tends to leave one with the view that, without Data Read, it is simply impossible.

Not so. When "Uncle Clive" said "Who needs Data Read?" he offered a string-handling facility which, in some respects, is actually superior to the normal data-handling routines. Using string-handling allows a much simpler, neater listing. The only disadvantage is that the game would slow down if the number of animals became too great. Dimensioning A$ at 2000 provides sufficient space for reasonable use, but the number can be increased without risk if you wish to become wider-ranging.

How, then, does string-handling work? Simply, the string is a chain of empty boxes, of a length fixed in a Dim statement. Each box can be filled by one character of our choice. Any part of the chain can be called upon. If Q$=BACON, the Q$(4 TO)=ON. There are two snags to this. The first is the need to know exactly which part of the chain is required and the second is the time taken to look at each box separately.

Fortunately, the cure for the second problem is also the clue to the first problem. Before each entry in the string a pointer is placed, indicating the length of the entry. Thus, if the first entry is "an elephant", the string would be as in figure 1.

This can be used to skip quickly along the string. To read entry 2, you read Q$(1) — the length of entry 1 — add on the value found there, move the pointer along to this value on Q$, and the next box — called Next Free Byte — is where the length of entry 2 will be stored.

Figure 1.

	Chr$ 11	A	N		E	L	E	P	H	A	N	T	NFB
Q$	1	2	3	4	5	6	7	8	9	10	11	12	13

To use this in our program, we need three entries for every animal: first, an animal; then a distinguishing question; finally, a defining answer. In each case the length of entry must be stored in front of it.

Lines 99 to 170 initialise the variables. Line 172 sends the program to the shortened version necessary for the first round of play. This is placed at the end, since it will not be used again.

(continued on next page)

(continued from previous page)

The subroutine at 180 is used each time new information is written into the string. The subroutine at 500 similarly reads all information from Q$. Notice that they are placed near the beginning for speed. Lines 510 to 540 move the pointer along the string in jumps indicated by the Chr$ placed in NFB. When S=0, you have reached the entry you need. Line 550 then reads the number of characters indicated in NFB. The version of the game needed for all subsequent rounds starts at line 1000.

Finally, provision is made for saving all new information when you leave the game. Line 3500 prepares to Save. When you press Newline at 3525 it will begin the Save routine leading to an auto-start. It is a good idea to record on alternate sides of the tape, so that a mistake still leaves you the last playable version.

Once playing, do remember to answer in English. When you suggest a question, you must use a question mark. Similarly, when you name an animal, do not forget to put "a" or "an" in front of it. ZX-81 uses the information exactly as you give it, so you must be accurate. Check your spelling before you press Newline. A mistyped word is there for ever.

```
  99 REM ■INITIALISE
 101 DIM Q$(2000)
 110 LET L=2
 140 LET P=1
 150 LET A$="AN ELEPHANT"
 160 LET NFB=1
 170 LET C=0
 172 GOTO 2000
 175 REM ■WRITE INTO Q$
 180 LET Q$(NFB)=CHR$ LEN A$
 190 LET Q$(NFB+1 TO NFB+LEN A$)
=A$
 195 LET NFB=NFB+1+LEN A$
 200 LET C=C+1
 205 LET N=C
 210 RETURN
 499 REM ■READ FROM Q$
 500 LET P=1
 505 LET S=C
 510 LET S=S-1
 520 IF S<=0 THEN GOTO 550
 530 LET P=P+1+CODE Q$(P)
 540 GOTO 510
 550 LET Z$=Q$(P+1 TO CODE Q$(P)
+P)
 560 RETURN
1000 PRINT "HAVE YOU THOUGHT OF
AN ANIMAL?"
1005 LET C=N-1
1010 INPUT A$
1020 IF CODE A$=62 THEN GOTO 104
0
1030 GOTO 1010
1040 IF C<1 THEN LET C=0
1044 GOSUB 500
1045 IF C=0 THEN GOTO 2117
1047 CLS
1050 PRINT ,,TAB 0;Z$;
1060 INPUT A$
1070 LET C=C+1
1080 GOSUB 500
1090 IF CODE A$=CODE Z$ THEN GOT
O 1120
1100 LET C=C-4
1110 GOTO 1040
1120 LET C=C-2
1130 GOSUB 500
1140 PRINT ,,TAB 0;"IS IT ";Z$;"
?"
1150 INPUT A$
1160 IF CODE A$<>62 THEN GOTO 12
00
1170 PRINT ,,TAB 0;"AREN■T I CLE
VER?"
1175 FOR I=1 TO 35
1176 NEXT I
1180 GOTO 3000
1200 LET C=N
1210 GOTO 2170
2000 GOSUB 180
2005 CLS
2010 PRINT "HAVE YOU THOUGHT OF
AN ANIMAL?"
2090 INPUT A$
2100 IF CODE A$=62 THEN GOTO 211
5
2110 GOTO 2090
2115 GOSUB 500
2117 PRINT
2120 PRINT TAB 0;"IS IT ";Z$;"?"
2130 INPUT A$
2140 IF CODE A$<>62 THEN GOTO 21
70
2145 PRINT
2150 PRINT "AREN■T I CLEVER?"
2155 FOR H=1 TO 50
2156 NEXT H
2160 GOTO 3000
2170 PRINT
2180 PRINT "WHAT WAS IT?"
2190 INPUT A$
2195 LET Y$=A$
2200 PRINT ,,"WHAT QUESTION COUL
D I ASK TO ,, DISTINGUISH BETWEE
N ";A$;TAB 0;"AND ";Z$;"?"
2205 GOSUB 180
2210 INPUT A$
2215 GOSUB 180
2220 PRINT ,,"WHAT WOULD THE ANS
WER BE FOR ";TAB 0;Y$;"?"
2230 INPUT A$
2235 GOSUB 180
2240 GOTO 3000
3000 CLS
3010 PRINT AT 8,3;"MAY I TRY AGA
IN?"
3020 INPUT Z$
3029 CLS
3030 IF CODE Z$=62 THEN GOTO 100
0
3499 REM ■SAVE
3500 CLS
3510 PRINT AT 8,5;"PLEASE PREPAR
E THE TAPE TO SAVE MY NEW INFORM
ATION."
3520 PRINT ,,TAB 5;"PRESS NEWLIN
E WHEN YOU ARE READY"
3525 IF INKEY$="" THEN GOTO 3525
3530 SAVE "ANIMAL■"
3535 CLS
3540 GOTO 1000
```

The machine-code loaders.

```
10 'LOADER 1
20 INPUT" ENTER START";S
30 LINE INPUT"DATA ";A$
40 PRINTA$
50 PRINT
60 POKES,VAL("&H"+LEFT$(A$,2)):A$=MID$(A$,4)
70 S=S+1:IF A$<>"" THEN 40 ELSE 30
10   LOADER 2
20 DATA 96,8C,ETC (MACHINE CODE DATA)
30 FOR F = START TO FINISH
40 READ A$:POKEF,VAL("&H"+A$)
50 NEXT
```

The machine code.

```
START - 4000
 4000 - 96
 4001 - 8C
 4002 - 81
 4003 - 13
 4004 - 25
 4005 - 1
 4006 - 39
 4007 - C6
 4008 - 20
 4009 - 3D
 4010 - C3
 4011 - 4
 4012 - 0
 4013 - 1F
 4014 - 1
 4015 - 30
 4016 - 1F
 4017 - C6
 4018 - 20
 4019 - 96
 4020 - 8D
 4021 - 27
 4022 - 5
 4023 - 86
 4024 - AA
 4025 - A7
 4026 - B4
 4027 - 3A
 4028 - 86
 4029 - 9F
 4030 - A7
 4031 - B4
 4032 - 3A
 4033 - 8C
 4034 - 6
 4035 - 0
 4036 - 25
 4037 - F8
 4038 - 39
START = 4100
 4100 - C6
 4101 - 20
 4102 - 8E
 4103 - 4
 4104 - 21
 4105 - 34
 4106 - 10
 4107 - A6
 4108 - B4
 4109 - A7
 4110 - 1F
 4111 - 3A
 4112 - 8C
 4113 - 6
 4114 - 0
 4115 - 25
 4116 - F6
 4117 - 35
 4118 - 10
 4119 - 30
 4120 - 1
 4121 - 8C
 4122 - 4
 4123 - 40
 4124 - 25
 4125 - EB
 4126 - 8E
 4127 - 4
 4128 - 3F
 4129 - 86
 4130 - 80
 4131 - A7
 4132 - B4
 4133 - 3A
 4134 - 8C
 4135 - 6
 4136 - 0
 4137 - 25
 4138 - F8
 4139 - 39
START = 4200
 4200 - 8E
 4201 - 4
 4202 - 0
 4203 - C6
 4204 - 80
 4205 - A6
 4206 - B4
 4207 - 81
 4208 - AA
 4209 - 26
 4210 - 5
 4211 - E7
 4212 - B4
 4213 - A7
 4214 - 88
 4215 - E0
 4216 - 30
 4217 - 1
 4218 - 1F
 4219 - 10
 4220 - C4
 4221 - 10
 4222 - 27
 4223 - 3
 4224 - 30
 4225 - 88
 4226 - 10
 4227 - 8C
 4228 - 6
 4229 - 0
 4230 - 25
 4231 - E3
 4232 - 8E
 4233 - 4
 4234 - 20
 4235 - 86
 4236 - 80
 4237 - A7
 4238 - 80
 4239 - 8C
 4240 - 4
 4241 - 40
 4242 - 26
 4243 - F7
 4244 - 39
START = 4300
 4300 - 8E
 4301 - 6
 4302 - 0
 4303 - A6
 4304 - 84
 4305 - 81
 4306 - 2E
 4307 - 26
 4308 - 16
 4309 - C6
 4310 - 80
 4311 - E7
 4312 - 84
 4313 - E6
 4314 - 88
```

(continued on page 155)

Scramble

Tony Eccles,
Leyland,
Lancashire.

DRAGON

THIS GAME USES only 1.5K and therefore can be greatly expanded. It uses both machine code and Basic. The object of the game is to see how long you can last without crashing or being blown up by a rocket. The rocket is

CHR$(170)

and the fuel is an inverse F. The keys used to play are the cursor keys, F and space-bar, The space-bar drops a bomb and F fires a missile. You get 20 points for hitting something with a bomb and 10 for hitting with a missile.

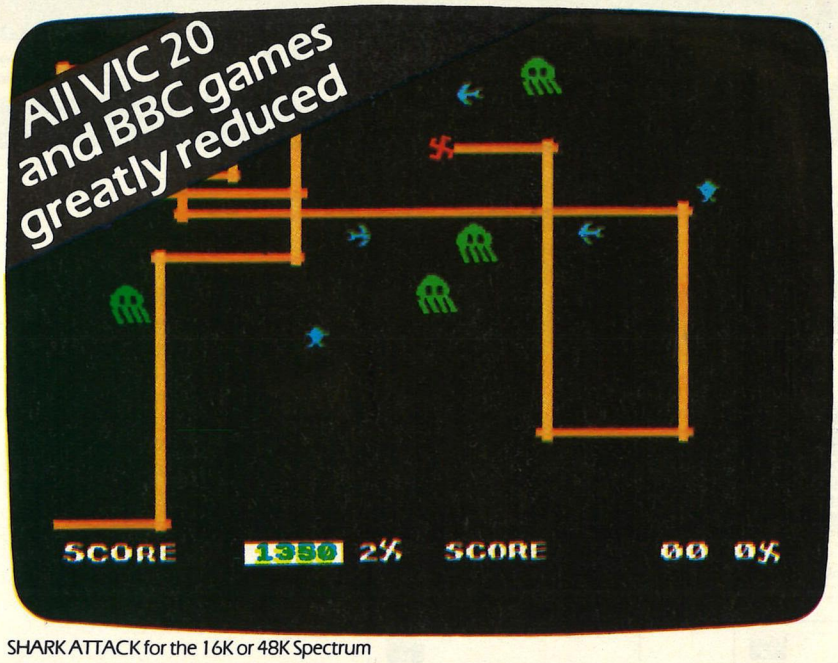
To load the program first type in the Basic — program 1 — that runs the game. Then Save this on tape. Next type in one of the two loader programs and begin typing in the machine code data, it is by the side of the mnemonics in the disassembly of my game, and check it. Finally check the machine code again then Save it on tape. There is a check in the Basic program to see if you have loaded the code — line 55 — if not then the program will stop. Also the reason for all the variables at the start is that this makes the program run quicker.

The machine code routines are as follows:

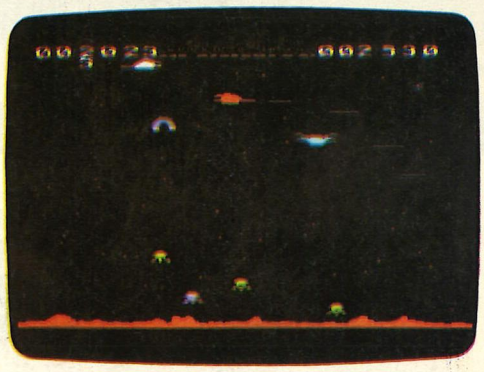
4000 draws the landscape
4100 scrolls the landscape to the left
4200 move up the missiles
4300 move the bombs down
4400 print the score
4500 sound of explosion
4600 sound of bomb
4700 sound of laser
4800 part of the sound routines

```
1 E0=4000:E1=4100:E2=4200:E3=4300:E4=4400:E5=4500:E6=4
600:E7=4700:T9=18
2 S0=0:S1=1:S2=2:S3=3:S4=4:S5=5:S6=6:S7=0.5:S8=10:S9=2
0
3 F1=341:F2=342:F3=343:F4=344:F5=345
4 L0=4024:L1=1060:L2=1024:Z1$=CHR$(128)+">=-":Z2$=STRI
NG$(5,128):H8=140
5 H0=100:H1=128:H2=141:H3=170:H4=179:H5=223:H6=251:H7=
480
6 T0=32:T1=96:T2=89:T3=90:T4=45:T5=46
10 M=0
20 POKE 65315,63
30 FORF=178 TO 181:POKEF,S0:NEXT
40 CLS S0:PRINT@S0,"score";:PRINT@S9,"ships"S3-M;
50 B=20:X=200
55 IF PEEK(4037)<>248 THEN PRINT:PRINT"PLEASE LOAD THE
 MACHINE CODE.":END
60 POKE H8,RND(S8)+S6:POKE H2,RND(S2)-S1:IF RND(S0)>S7
 THEN POKE L0,S6 ELSE POKE L0,H3
70 EXEC E0
80 EXEC E1
90 PRINT@X-S1,Z1$;
```

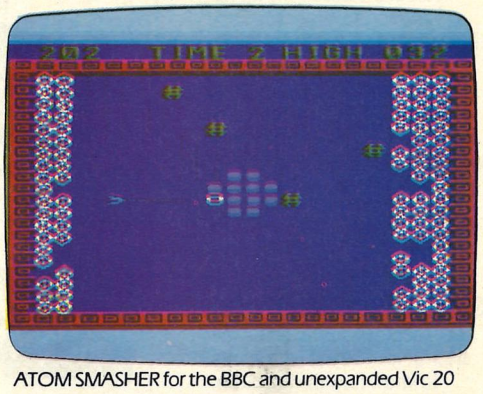
(continued on page 155)



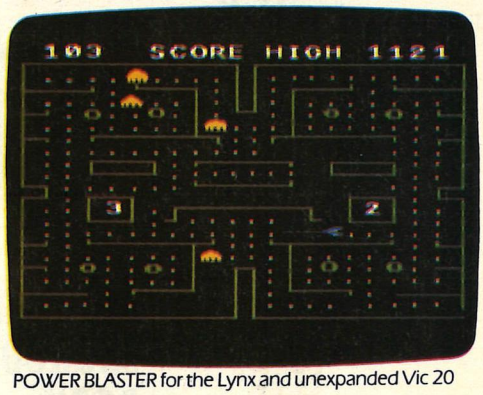
SHARK ATTACK for the 16K or 48K Spectrum



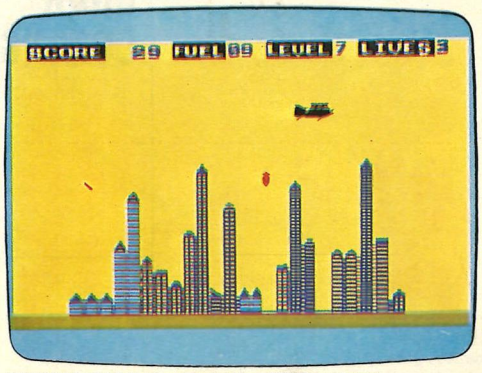
TIME DESTROYERS for the expanded Vic 20 (3K+)



ATOM SMASHER for the BBC and unexpanded Vic 20



POWER BLASTER for the Lynx and unexpanded Vic 20



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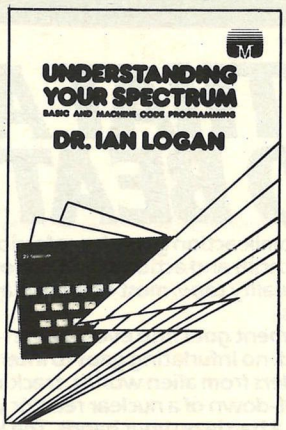

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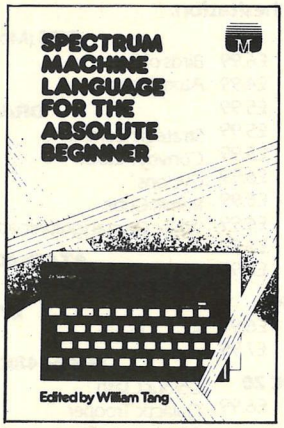

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MELBOURNE HOUSE

(continued from page 152)

```
4315 - 22
4316 - C1
4317 - 80
4318 - 27
4319 - 8
4320 - 96
4321 - B3
4322 - 8B
4323 - 14
4324 - 97
4325 - B3
4326 - 86
4327 - 80
4328 - A7
4329 - 88
4330 - 22
4331 - 30
4332 - 1F
4333 - 8C
4334 - 4
4335 - 0
4336 - 24
4337 - DD
4338 - 39
START = 4400
4400 - DC
4401 - B4
4402 - D3
4403 - B2
4404 - DD
4405 - B4
4406 - F
4407 - B3
4408 - BD
4409 - 95
4410 - 7A
4411 - 39
START = 4500
4500 - 8E
4501 - 5
4502 - C0
4503 - A6
4504 - 84
4505 - 97
4506 - 8C
4507 - F6
4508 - 1
4509 - 13
4510 - D7
4511 - BD
4512 - 56
4513 - D7
4514 - BE
4515 - BD
4516 - 12
4517 - C0
4518 - 30
4519 - 1
4520 - 8C
4521 - 6
4522 - 0
4523 - 26
4524 - 1
4525 - 39
4526 - 7E
4527 - 11
4528 - 97
START = 4600
4600 - C6
4601 - D0
4602 - D7
4603 - 8C
4604 - D7
4605 - BD
4606 - D7
4607 - BE
4608 - BD
4609 - 12
4610 - C0
4611 - 5C
4612 - 26
4613 - F4
4614 - 39
START = 4700
4700 - C6
4701 - 4
4702 - 96
4703 - 8C
4704 - 8B
4705 - 4F
4706 - 97
4707 - 8C
4708 - BD
4709 - BA
4710 - D4
4711 - BD
4712 - BA
4713 - D6
4714 - 5A
4715 - 26
4716 - F1
4717 - 39
4718 - 5A
4719 - 26
4720 - ED
4721 - 39
START = 4800
4800 - BD
4801 - BA
4802 - D4
4803 - 96
4804 - BD
4805 - BD
4806 - BA
4807 - D6
4808 - BD
4809 - BA
4810 - D4
4811 - 96
4812 - BE
4813 - BD
4814 - BA
4815 - D6
4816 - 39
```

(continued from page 152)

```
100 R=X
110 IF PEEK(F1)=H5 AND X>T1 THEN X=X-T0:GOTO 160
120 IF PEEK(F4)=H5 AND B>T9 THEN B=B-S1:X=X+S1:GOTO 16
0
130 IF PEEK(F3)=H5 AND B<S9 THEN B=B+S1:X=X-S1:GOTO160
140 IF PEEK(F2)=H5 AND X<H7 THEN X=X+T0:GOTO 160
150 GOTO 170
160 PRINT@R-S2,Z2$;
170 IF PEEK(F5)=H5 THEN POKE X+L1,T5:EXEC E6
180 EXEC E3
190 IF PEEK(F4)=H6 THEN 290
200 EXEC E2
210 D=L2+X
220 F=S0
225 I=PEEK(D+F):IF I<H0 OR I>H1 THEN F=T2
226 F=F+S1:IF F<4 THEN 225
250 IF F>T2 THEN 350
260 IF PEEK(H4)=S0 THEN 60
270 PRINT@S5,"";:EXEC E4
280 GOTO 60
290 D=L2+X
300 F=S4
310 IF PEEK(F+D)<>H1 THEN POKEF+D,H1:POKE H4,S8:F=T3:A
M=AM+S8:GOTO 330
320 POKEF+D,T4:FORH=1 TO 10:NEXT:POKEF+D,H1
330 EXEC E3:EXEC E7:F=F+S1:IF F<=B THEN 310
340 GOTO 200
350 PRINT@X,"xxxx";:FOR F=1 TO 10:EXEC E5:NEXT
360 M=M+S1:IF M>S3 THEN PRINT@T0,">GAME OVER<";:END
370 FORF=1 TO 1000:NEXT
380 GOTO 40
```

Mini synthesiser

Adam Barnes,
Huntingdon,
Cambridgeshire.

BBC

THIS PROGRAM is for a mini synthesiser using the BBC Model A or B. It will allow the user to key music directly from the keyboard, with four note variations and six different rhythm accompaniments. The pattern of the keys used to play music similar to the arrangement on a normal keyboard instrument, thus:

Black notes: S D G H J
White notes: Z X C V B N M ?

Two octaves may be accessed. Holding down the Shift key engages the top octave. Pressing one of the keys f0 to f3 changes the sound of the note played, thus:

- f0: Ping-type tone.
- f1: Ping-type tone with long echo.
- f2: Fantasy-type vibrato sound.
- f3: Vibrato with echo.

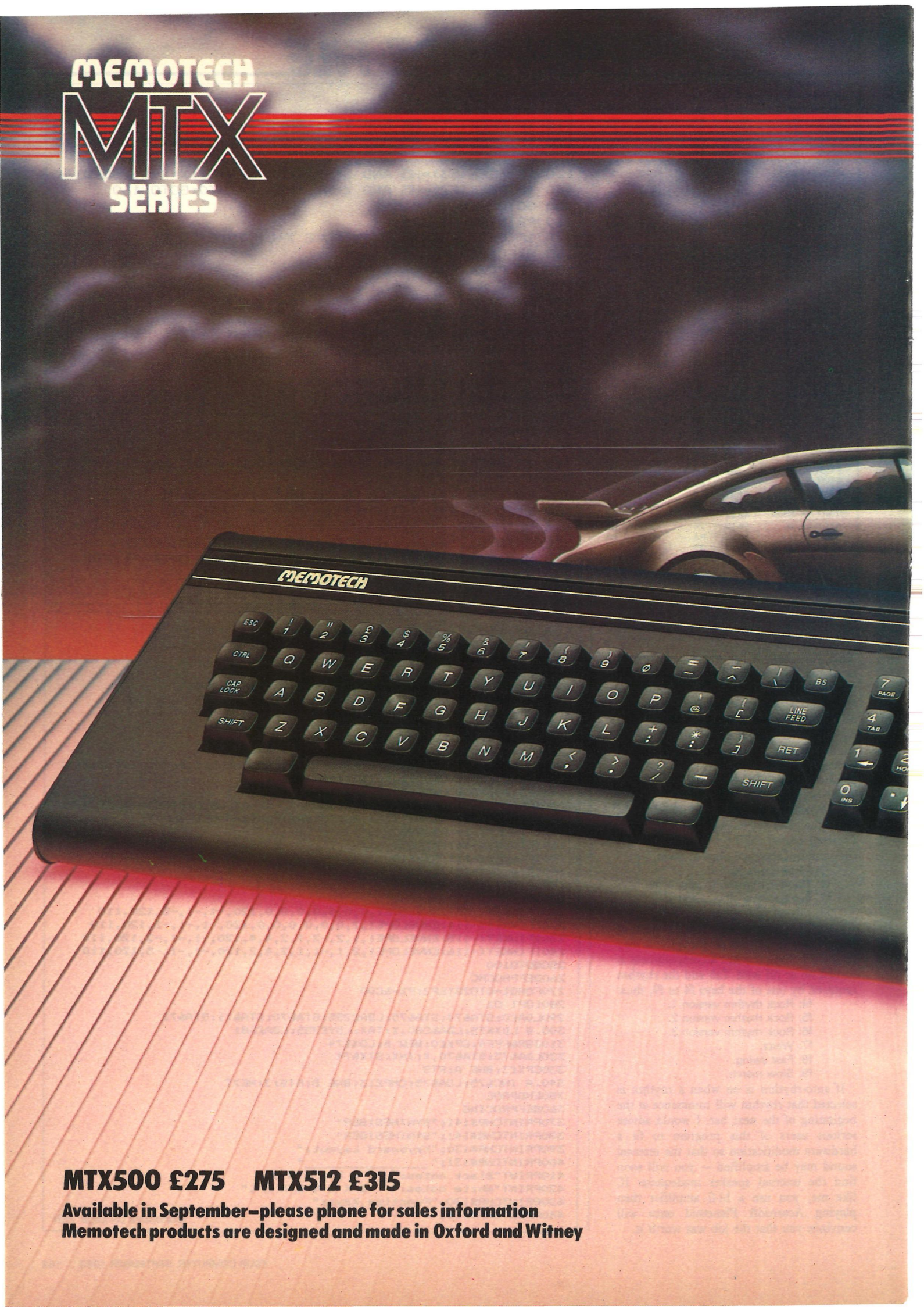
Chords — this being a main feature of the program — of two or three notes may be played. Auto-rhythm accompaniment is turned on or off with Tab and the rhythm required by one of the keys f4 to f9, thus:

- f4: Rock rhythm version 1.
- f5: Rock rhythm version 2.
- f6: Rock rhythm version 3.
- f7: Waltz.
- f8: Fast swing.
- f9: Slow march.

If auto-rhythm is on when a rhythm is selected that rhythm will commence at the beginning of the next bar. I would advise serious users of this program to fit a hardware modification so that the internal sound may be amplified — you will soon find the internal speaker inadequate. If, like me, you use a hi-fi amplifier then playing Acornsoft Planetoid once will convince you that the job was worth it.

```
 5 REM FOR £ READ HASH CHARACTER
10REM ***SYNTHESISER***
20REM A.BARNES 1983
30*TV255
40ENVELOPE1,0,0,0,0,0,0,0,120,-1,-1,-5,120,110
50ENVELOPE2,0,0,0,0,0,0,0,126,-10,-1,-1,126,96
60MODE7:RESTORE:PROCMC:PROCINS
70R%=590:J%=0
80FORA%=0TO12:READB%:A%?&C80=B%:NEXT
90FORA%=0TO3:SOUND&10+A%,0,0,1:NEXT
100CALL&C00:Z%=INKEY(-1)*-48:IF?&70<255SOUND&11,1,?&70*4+48+Z%,1
110IF?&71<255SOUND&12,1,?&71*4+48+Z%,1
120IF?&72<255SOUND&13,1,?&72*4+48+Z%,1
130IFADVAL(-5)>0READA%,B%,C%:SOUND0,-J%*A%,B%,C%:IFC%=0RESTORER%
140IFINKEY(-97)J%=NOT(J%):RESTORER%:FORI%=0TO999:NEXT
150IFINKEY(-21)R%=590
160IFINKEY(-117)R%=650
170IFINKEY(-118)R%=710
180IFINKEY(-23)R%=760
190IFINKEY(-119)R%=820
200IFINKEY(-120)R%=860
210IFINKEY(-33)ENVELOPE1,0,0,0,0,0,0,0,120,-1,-1,-5,120,110
220IFINKEY(-114)ENVELOPE1,2,0,0,0,0,0,0,120,-1,-1,-1,120,110
230IFINKEY(-115)ENVELOPE1,1,2,-2,1,2,4,4,120,-1,-1,-2,120,110
240IFINKEY(-116)ENVELOPE1,2,1,-1,1,2,4,2,120,-1,-1,-5,120,110
250GOTO100
260DEFPROCMC
270FOR0%=0TO2STEP2:P%=&C00
280[OPT 0%
290LDA£0:STA&74:STA&75:LDA£255:STA&70:STA&71:STA&72
300.B LDX&75:LDA&C80,X:TAX:LDY£255:LDA£&81
310JSR&FFF4:CPX£0:BEQ A:LDX&74
320LDA&75:STA&70,X:INX:STX&74
330CPX£3:BNE A:RTS
340.A INC&75:LDA&75:CMP£13:BNE B:RTS:]:NEXT
350ENDPROC
360DEFPROCINS
370PRINTCHR$141;"SYNTHESISER"
380PRINTCHR$141;"SYNTHESISER"
390PRINTCHR$130;"Keyboard Layout:"
400PRINTCHR$131;"_______________"
410PRINT"Black notes:      S D   G H J"
420PRINT"White notes:    Z X C V B N M ,"
430PRINTCHR$130;"Function Keys:"
440PRINTCHR$131;"              "
```

(continued on page 159)



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Software

The MTX's 16k ROM contains several languages and routines which enable the novice or the experienced programmer to make full use of the machine. Standard languages are MTX BASIC, LOGO type commands, and NODDY. ROM routines include an ASSEMBLER/ DISASSEMBLER with screen display of the Z80 CPU registers, memory and program, which can be manipulated from the keyboard. Machine code programs can be stepped through one instruction at a time, and easily called from within BASIC programs. A further feature is the Virtual Screen facility which enables the programmer to define sections of the screen to work independently whilst maintaining all full screen facilities. Pascal is available as an add-on ROM pack.

Hardware

The MTX500 has 32k of user RAM as standard (64k on the 512), expandable to 512k plus 16k of dedicated video RAM. Sixteen colours, 40 column text, 256 x 192 high resolution graphics with all sixteen colours available, and easily moveable user defined graphics (Sprites) combine to make effective screen displays quick and simple to achieve. Standard outputs are centronics printer port, two joystick ports, an uncommitted I/O port, 2400 Baud Cassette port, separate TV and Video Monitor ports, 3 voice sound with hifi output plus a dedicated games cartridge port. Other standard features include the Z80A processor running at 4MHz, real time clock, full moving key keyboard with 79 keys including eight function keys and separate numeric pad.

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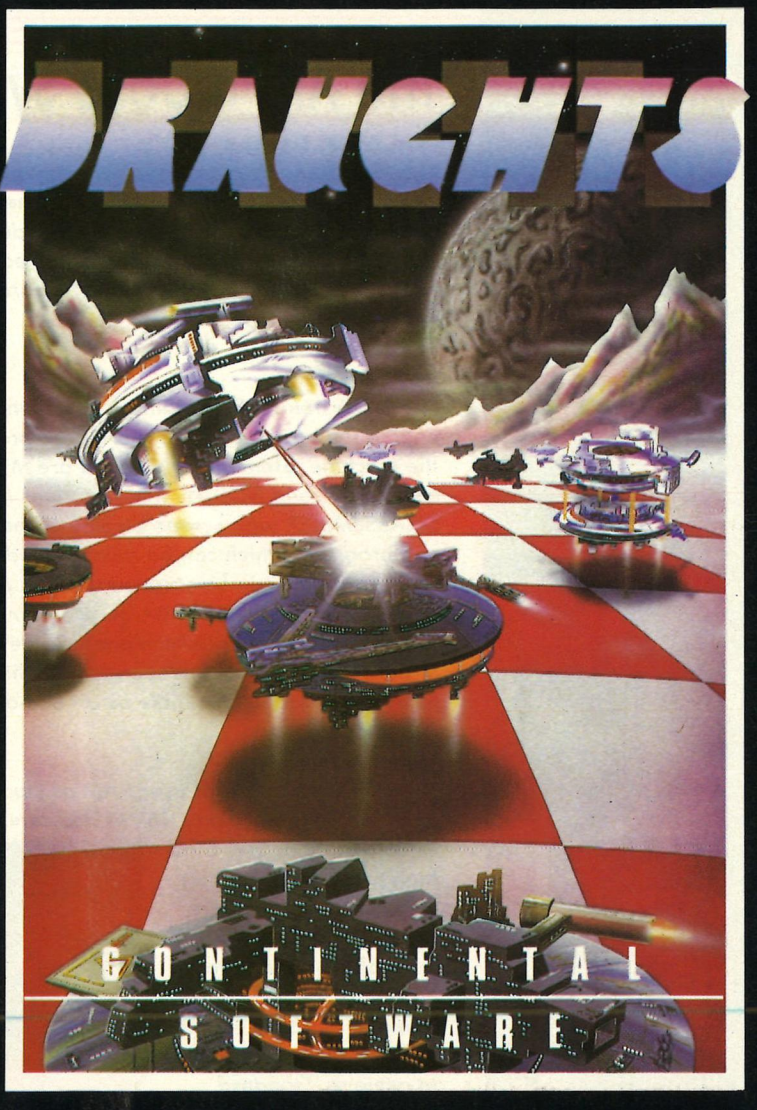

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CHESS, BACKGAMMON, OTHELLO, DRAUGHTS.

EDUCATION PROGRAMS

MATHS 1 PHYSICS 1

The first two programs in a series of specially written software designed to teach at the pace and level best suited to the user.

Software for the MTX SERIES

CONTINENTAL SOFTWARE UNIT 24 STATION LANE WITNEY

(continued from page 155)

```
450PRINT"f0:'Ping'type tone from keys."
460PRINT"f1:'Ping'type tone with long echo."
470PRINT"f2:Fantasy;fast vibrato sound."
480PRINT"f3:Medium vibrato-echo."
490PRINT"f4:Rock rhythm 1."
500PRINT"f5:Rock rhythm 2."
510PRINT"f6:Rock rhythm 3."
520PRINT"f7:Waltz."
530PRINT"f8:Fast swing."
540PRINT"f9:Slow march."
550PRINT"  TAB:Auto rhythm on/off."
560PRINT"SHIFT:Hold down to engage top octave."
570PRINT'CHR$136;"*** PLAY NOW ***":ENDPROC
580DATA-98,-82,-67,-51,-83,-100,-84,-101,-85,-86,-70,-102,-103
590DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,2,0,0,2
600DATA2,6,2,0,0,2,2,6,2,0,0,2,2,4,1,0,0,1,2,4,1,0,0,1,2,4,1,0,0,1,
2,4,1,0,0,1
610DATA2,6,2,0,0,2,2,6,2,0,0,2,2,4,2,0,0,2,2,6,2,0,0,2
620DATA2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1
630DATA2,6,1,0,0,1,2,6,1,0,0,1,2,6,1,0,0,1,2,6,1,0,0,1
640DATA0,0,0
650DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
660DATA2,6,1,0,0,1,2,4,1,0,0,1,2,6,2,0,0,2,2,4,3,0,0,1,2,6,2,0,0,2
670DATA2,6,2,0,0,2,2,6,2,0,0,2,2,4,2,0,0,2,2,6,2,0,0,2
680DATA2,5,1,0,0,3,2,5,1,0,0,1,2,5,1,0,0,1
690DATA2,6,1,0,0,3,2,6,1,0,0,1,2,6,1,0,0,1
700DATA0,0,0
710DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
720DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
730DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
740DATA2,5,3,0,0,5,2,5,3,0,0,3,2,6,1,0,0,1
750DATA0,0,0
760DATA2,6,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
770DATA2,6,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
780DATA2,6,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
790DATA2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1
800DATA2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1
810DATA0,0,0
820DATA2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,6,1,0,0,1
830DATA2,4,2,0,0,2,2,6,1,0,0,1,2,6,1,0,0,1
840DATA2,4,2,0,0,2,2,5,2,0,0,2,2,5,2,0,0,2
850DATA0,0,0
860DATA2,4,8,0,0,4,2,4,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
870DATA2,6,4,0,0,4,2,4,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
880DATA2,5,3,0,0,5,2,6,3,0,0,5
890DATA0,0,0
```

Tron II

H Singh,
Birmingham.

VIC-20

THIS IS A TWO-PLAYER game of skill based on the light-cycle game in the film Tron. It runs on the unexpanded Vic-20 and uses the Vic's sound and high-resolution graphics facilities to the full. The two players play the roles of Tron and the MCP and the objective of the game is to move along the grid trying to trap the opponent while avoiding the walls and trails. The first player to win 10 rounds wins the game.

Tron, who leaves the blue trail, uses the Commodore and Shift keys. The MCP, who leaves the red trail, uses the cursor keys. The keys move you anti-clockwise or clockwise by 90°.

The program has two parts; the initialisation program which sets up the graphics and the main program which plays the game. Type in both programs and Save them before running. The structure of the main program is as follows:

10	Changes screen colour and sets up the variables
15 to 45	Set up graphic screen
70 to 95	Tron keyboard entry and check for crash
100 to 125	MCP keyboard entry and check for crash
500 to 630	Movement routines
1000 to 2010	Crash routines
2340 to 2900	Print winner and ask for replay

```
25 REM*INITIALISATION*
30 REM*****************
35 PRINTCHR$(142)CHR$(8)
40 POKE52,28:POKE56,28:FORI=28TO57:FORJ=0TO7:READN:POKE7168+8*I+J,N:NEXT:NEXT
45 END
50 DATA198,230,246,222,206,198,198,198
55 DATA126,126,16,16,24,24,24,24,248,200,200,248,240,216,216,216
60 DATA252,252,204,204,204,204,252,252,0,0,0,0,0,0,0,0
65 DATA0,24,24,0,0,24,24,0,198,238,254,214,198,198,198,198
70 DATA254,254,198,192,192,198,254,254,252,252,204,204,252,192,192,192
75 DATA12,12,12,12,255,255,12,12,24,36,66,90,219,219,66,126
80 DATA126,66,90,90,219,195,36,24,12,252,130,185,185,130,252,12
85 DATA12,63,65,157,157,65,63,12,4,4,168,168,169,169,40,40
90 DATA40,40,42,42,106,106,4,4,4,4,42,42,106,106,40,40
95 DATA40,40,168,168,169,169,4,4,4,4,170,170,170,170,4,4,40,40,40,40,105,105,40
40
100 DATA126,126,102,102,102,102,126,126,56,56,24,24,24,24,60,60
105 DATA126,126,6,126,126,96,126,126,126,126,6,126,126,6,126,126
110 DATA96,96,108,108,126,126,12,12,126,126,96,126,126,6,126,126
115 DATA126,126,96,126,126,102,126,126,126,126,102,12,24,48,48,48
120 DATA126,126,102,126,126,102,126,126,126,126,102,126,126,6,126,126
```

```
  1 REM*    TRON II    *
  3 REM*  MAIN PROGRAM *
  4 REM*****************
  5 POKE36878,10:POKE36869,255:CLR:PRINTCHR$(147)CHR$(8)
  10 POKE36879,24:POKE36865,200:CO=30720:M=7904:T=7970:T1=1:M1=1:PRINT"■"
  15 FORI=7724TO8163:POKEI,37:POKEI+CO,0:NEXT
  20 POKE7702,44:POKE7702+CO,12:POKE7723,42:POKE7723+CO,12:POKE8164,43:POKE8164+C
O,12
  25 POKE8185,45:POKE8185+CO,12
  30 FORI=7703TO7722:POKEI,46:POKEI+CO,12:POKEI+462,46:POKEI+462+CO,12:NEXT
  35 FORI=7724TO8142STEP22:POKEI,47:POKEI+CO,12:POKEI+21,47:POKEI+21+CO,12:NEXT
  40 POKEM-1,46:POKEM-1+CO,10:POKEM,40:POKEM+CO,0:POKET-1,46
  43 POKET-1+CO,14:POKET,40:POKET+CO,0
  45 POKE198,0:PRINT"■■■■]↑←\!■■■■■■"+CHR$(34)+"#$!"
  50 POKE36865,38:PRINT"■"TAB(7)TSTAB(17)MS
  70 POKE36876,225:A=PEEK(653)
  80 IFA=2THENT2=-22*(T1=-1)+1*(T1=-22)+22*(T1=1)-1*(T1=22):GOTO90
  85 IFA=1THENT2=-22*(T1=1)-1*(T1=-22)+22*(T1=-1)+1*(T1=22):GOTO90
  88 T2=T1
  90 IFPEEK(T+T2)<>37THEN1000
  95 GOSUB500:POKE36876,0:T1=T2
  100 B=PEEK(197)
  105 IFB=31THENM2=-22*(M1=-1)+1*(M1=-22)+22*(M1=1)-1*(M1=22):GOTO118
  115 IFB=23THENM2=-22*(M1=1)-1*(M1=-22)+22*(M1=-1)+1*(M1=22):GOTO118
  116 M2=M1
  118 IFPEEK(M+M2)<>37THEN2000
  125 GOSUB600:M1=M2:GOTO70
  500 RESTORE
  505 READA,B,P,CH
  510 IFT1=AANDT2=BTHENPOKET,P:POKET+CO,14:T=T+B:POKET,CH:POKET+CO,0:RETURN
  520 GOTO505
  530 DATA1,1,46,40,-1,-1,46,41,22,22,47,39,-22,-22,47,38
  535 DATA1,-22,45,38,1,22,42,39,-1,-22,43,38,-1,22,44,39
  540 DATA22,-1,45,41,22,1,43,40,-22,-1,42,41,-22,1,44,40
  600 RESTORE
  610 READA,B,P,CH
  620 IFM1=AANDM2=BTHENPOKEM,P:POKEM+CO,10:M=M+B:POKEM,CH:POKEM+CO,0:RETURN
  630 GOTO610
  1000 POKET+CO,2:POKE36874,200:FORI=1TO4000:NEXT:POKE36874,0:POKE36876,0:MS=MS+1
  IFMS=10THEN2500
  1010 GOTO10
  2000 POKEM+CO,2:POKE36874,200:FORI=1TO4000:NEXT:POKE36874,0:TS=TS+1:IFTS=10THEN
2500
  2010 GOTO10
  2340 IFMS>TSTHENPRINT"■THE■ "CHR$(34)"#$"
  2350 IFTS>MSTHENPRINT"]↑←\"
  2360 GOTO2800
  2500 PRINT"■■       ■]■■■←■\ 11"
  2510 PRINT"       ■■■■■■■■■■■■■■"
  2525 PRINT"■■  ■THE WINNER OF THE"
  2530 PRINT"■  ■GAME IS ";
  2540 IFMS>TSTHENPRINT"THE ■"CHR$(34)"#$"
  2560 IFTS>MSTHENPRINT"■]↑←\"
  2800 PRINT"■■■  ■ANOTHER GAME (Y/N)"
  2810 GETA$:IFA$="Y"THENRUN
  2820 IFA$<>"N"THEN2810
  2900 SYS64802
```

Death worm

K R Littlefield,
Carshalton,
Surrey.

ZX-81

DEATH WORM IS A variation on the arcade game Centipede. Most of the action is performed by machine-code routines thus making the game fast.

There are four main machine-code routines — move worm, move base and fire, move bombs and the master program.

First, you must reserve some space for the code. Do this by entering:

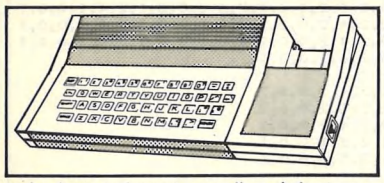
```
1 REM (95 x's)
2 REM (98 x's)
3 REM (74 x's)
4 REM (24 x's)
```

then enter the code loader — listing 1. Run

(continued on page 167)

HOME COMPUTERS

20K AQUARIUS



AQUARIUS: The brand new Aquarius Personal Computer is part of Mattel Electronics latest developments in advanced technology and offers full home computing facilities, as well as extensive game play, using a very wide range of plug in cartridges. Since Aquarius is a Mattel Electronics product, it benefits by the company's wide experience of producing high technology equipment, as well as their game programming expertise which is evident from the advanced games which have been produced for the Intellivision. Aquarius costs £99 and comes with microsoft basic built in. It is so simple to use that you'll be writing your first programs within minutes of taking the machine out of its box. You can even record the programs on your own cassette recorder at home, so you can use them again at a later date. Most available domestic tape recorders are compatible with the Aquarius.

A POWERFUL MACHINE: For all it's simplicity, it is also very sophisticated. It has a Z80A processor and it comes with 8K of built in ROM and 20K of RAM, expandable to 52K. It has a display of 40x24 characters, and a graphic resolution of 320x192 with a total character set of 256 (including the complete ASCII set with upper and lower case letters, numbers and additional graphic symbols). The keyboard has 49 full stroke moving keys, unlike some of the cheaper machines which have membrane keyboards. The size of the machine (excluding any of the additional peripherals), is 13"x6"x2".

PERIPHERALS: It is very easy to increase the capabilities of your Aquarius as all the peripherals plug straight into one another. You can add a Printer, a Modem, a Data Recorder, Mini Expander and other items. All of the peripherals are very easy to install and what is more, they're easy to use. But the best news of all is, they're easy to afford.

CPM OPERATING CAPABILITY: The Aquarius is capable of being expanded to 52K RAM and later in 1983 a disk drive will be available for it, with the commercial CPM business operating system. This will allow you access to one of the largest software libraries in the world, with literally hundreds of programs available for you to use.

CARTRIDGES: Various sophisticated programs will be launched on plug in cartridges such as a Visicalc type spreadsheet and a word processor. In addition there will be dozens of games and utilities and alternative languages such as Logo, which combined with the built in microsoft basic gives an unbeatable combination of high quality programming ability.

20K MATTEL AQUARIUS – £86 + VAT = £99

£99

ATARI 400/800

NEW LOW PRICES

ATARI 400/800: With the Atari Personal Computers, you can play the ultimate in T.V. games, teach yourself new subjects or skills, balance budgets, and even write your own computer programs in Basic.

SPECIFICATIONS: Both the Atari 400 and 800 can display in up to 16 colours, each with 16 intensities. They have four independent sound synthesizers for music tunes/game sounds, giving four octaves with variable volume and tone control on your T.V.'s speaker. The display graphics are of amazing quality, having a detailed resolution of 320 x192, comprising 24 lines of 40 characters. Atari personal computers have a standard 10K ROM operating system. In addition the standard Atari 400 (£129) comes with 16K of RAM and the expanded version with 48K (£178). The Atari 800 (£279) comes with 48K as standard. Both the 400 and 800 are now supplied with a FREE £40 Basic Programming Kit, which includes the Basic Programming Cartridge, as well as a 120 page Basic Reference Manual and the 184 page Self Teaching Manual by Bill Carris called 'Inside Atari Basic', so you can begin programming straight away, without buying any 'extras'. Even a mains plug is supplied!

OVER 500 PROGRAMS AVAILABLE: The Atari computers are supported by well over 500 programs available for your use, a larger selection than you will find on any other television game or home computer! The wide selection puts Atari way ahead of the competition. Just fill in the coupon and we will be pleased to send you a full price list which gives details of our range of software available for entertainment, home education, programming and home office use. We think you'll agree when we say it's quite impressive.

100 FREE PROGRAMS FROM SILICA SHOP: If you buy your Atari Home Computer from Silica Shop, you will recieve a FREE presentation pack of 6 cassettes, containing 100 programs including games, utilities and demonstrations. A 16 page booklet giving full details of all of these programs is available on request. If you have already purchased your computer elsewhere you can buy the set of 6 cassettes for £30. What's more, Silica Shop offer a two year guarantee on all computers as well as a FREE joystick. This adds up to a great offer that we believe can't be beaten or matched by any of our competitors.

ATARI 400 WITH 16K £129
ATARI 400 WITH 48K £178
ATARI 800 WITH 48K £279

£129

VIDEO GAMES

COLECOVISION

THE SYSTEM: The CBS Colecovision offers new standards in video game play. The excellent graphics are well implemented with arcade titles such as Zaxxon, Lady Bug, Gorf, Wizard of Wor, Carnival, Mouse Trap and the lovable Smurfs. The console comes supplied with a three screen arcade quality version of DONKEY KONG. Parker and other companies have also announced ranges of cartridges for Colecovision, to further enhance the wide range of quality titles available for this new television games machine.

THE CONSOLE: The CBS Colecovision video games system has advanced technology which produces superlative graphics resolution and excellent sound effects. The styling of the console and hand controllers has been carefully researched; the console is designed to complement modern hi-tech equipment, and has clear features for easy operation. The hand controllers allow fingertip control via the 8 direction joystick, and feature 2 independent fire buttons. The push button keyboard is used for game selection and for game control with some cartridges. The hand controllers are detachable and are connected to six feet of telephone coil cable, storing neatly away in the console when not in use.

ATARI EXPANSION MODULE: The Atari converter module allows Atari VCS software cartridges to be played on the Colecovision console, allowing owners the freedom to purchase from the extensive range of Atari compatible cartridges. It also means that existing Atari owners can buy the CBS Colecovision games system without discarding their software library. Silica Shop offer part exchange facilities if you wish to upgrade.

TURBO EXPANSION MODULE: The Turbo Driver Expansion Module allows you to actually drive the vehicle that appears on your T.V. screen. The module consists of a steering wheel, dashboard and accelerator pedal. One hand controller is mounted on the dashboard to provide a gear change unit. The module comes complete with a Turbo Driver cartridge, the first of several cartridges to make use of the module, which provides all the action of sitting in the driving seat. This facility is unique to CBS Colecovision.

HOME COMPUTER EXPANSION MODULE: The Home Computer Module scheduled for late 1983, allows conversion of the games unit into a sophisticated Home Computer. This flexibility of design is an important feature of the CBS Colecovision System.

COLECOVISION - £127.82 + VAT = £147

£147

VECTREX

THE SYSTEM: Vectrex is a totally unique Home Arcade System, which has been exclusively designed and engineered to duplicate real arcade game play. Complete with its own monitor display, Vectrex won't cause any arguments over the use of the family's television because it has its own built in screen.

THE SCREEN: Vectrex does not use ordinary display techniques, instead it uses vector scanning to control the images on the screen. With this scanning method, the gun only updates the area of the screen that has changed, whereas a normal T.V. re-transmits the ENTIRE screen 50 times a minute. It is this that gives Vectrex its speed, and means that very little computer power is required for screen control, and the results provide very fast responding and clear images. These 'Vector Graphics' are used in several arcade games such as Asteroids and Battlezone, to give you incredibly high resolution and quality. Vectrex brings all of this from the arcade right into your living room. The Vectrex screen is capable of displaying 80 columns by 40 lines, which is significant to the extensive developments planned for the system.

EXCITING SOUNDS AND ELECTRONICS: Vectrex has an advanced microprocessor with more speed and power and exciting effects than many home video games systems.

REAL ARCADE CONTROLS: Vectrex has a unique control panel, similar to those used in many real arcade games, with 4 concave action buttons and a full 360° self centering joystick. This control panel has a 4 foot detachable cord for maximum player freedom.

REAL ARCADE GRAPHICS: Vectrex has its own 9 inch vertical screen and unlike a conventional T.V. screen, uses advanced display technology to achieve brilliant, high resolution imagery and superb game play never before possible. The Vectrex display provides special effects too, such as 3-D rotation and zooming in and out, which a regular T.V. cannot match. Using a black and white monitor, each Vectrex game comes supplied with its own coloured plastic screen overlay to add to the excitement of game play. The range of Vectrex cartridges (£19.95 each), gives a good selection of arcade games such as Berzerk, Scramble, Rip-Off and Bomber Attack. Vectrex comes complete with a fast paced 'Minestorm' game built into memory.

VECTREX: Vectrex has an advanced state-of-the-art microprocessor with more speed than other T.V. games.

VECTREX – £112.17 + VAT = £129.00

£129

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- **2 YEAR GUARANTEE** - we offer a 1 year extension on some manufacturers 12 month guarantee, including Atari Personal Computers.
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Brain Games
Breakout
Casino
Centipede
Checkers
Chess
Circus
Codebreaker
Combat
Concentration
Defender
Demons/Diams
Dig Dug
Dodge'em
E.T.
Football/sccr
Fun with Nos
Galaxian
Golf
Gravitar
Hangman
Haunted Hse
Human Cann
Hunt & Score
Indy 500
Jungle Hunt
Kangaroo
Krull
Math G Prix
Maze Craze
Min Golf
Missile Cmnd
Ms Pac-Man
Night Driver
Olympics
Othello
Outlaw
Pac-Man
Phoenix
Pinball
Pole Postn
Raiders of L/A
Sky Diver
Slot Racers
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Space War
Star Raiders
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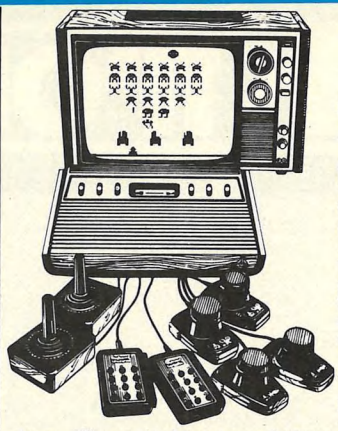
Superman



ATARI

ATARI VCS (2600) – THE NO 1 BRAND LEADER IN THE U.K.

ATARI: The Atari Video Computer System known as the Atari VCS or the 2600 has now become the T.V. game brand leader. In the U.K. there are over 700,000 owners of the VCS with access to a range of over 200 different plug in cartridges, each having a multitude of different variations and difficulty levels. Every system comes complete with the main console, two individual joystick controllers, a pair of paddle controllers, aerial splitter, mains adaptor, a 27 game Combat cartridge and a **FREE** 112 game **SPACE INVADERS** cartridge. The console also incorporates special circuits designed to protect your T.V. set.

SECONDHAND GAMES: We currently have several secondhand Atari VCS units in stock which we are selling for only £39 (inc VAT). This price includes the Console, with Combat Cartridge and all the accessories, as well as a 12 month guarantee. We also have stocks of several secondhand cartridges many at half price (all with 12 month guarantee). We will normally buy back secondhand units and cartridges at ¼ of our normal selling price.

£39

EXTENSIVE CARTRIDGE RANGE: The Atari VCS is so popular that in addition to Atari's own cartridges, there are over 150 compatible cartridges, produced by at least a dozen different third party manufacturers. Silica Shop has one of the largest cartridge selections available in the U.K. Our range of over 200 titles (printed either side of this column), includes items in stock now, as well as many of the new releases for later in 1983.

SILICA ATARI CLUB: Silica Shop has over 20,000 Atari VCS club members registered on our computer. As a specialist company we are able to obtain advance information about new developments and send detailed catalogues to all of our club members, enabling them to evaluate new products before they buy. This is a totally FREE service, to receive your copies complete the coupon below.

SERVICE CENTRE: Atari International (UK) Inc has recently appointed Silica Shop as an authorised Atari Service Centre. This means that we can now service your Atari VCS or 400/800 (under guarantee if applicable), whether or not you purchased it from us.

VCS COMPUTER KEYBOARD: A keyboard will soon be launched to convert the VCS into a fully programmable home computer. For further details, join our club by completing the coupon below. We will then let you know when further information is available.

STARPATH SUPERCHARGER: The supercharger plugs into the cartridge socket of your VCS and expands its RAM almost 50 fold, from 128 to 6,272 bytes. This increased memory adds vivid high resolution graphics capabilities and significantly lengthens the game playing time. Supercharger has a range of multi-load games (at £19.45 each), these offer the facility to play a game in several distinct parts (great for adventures), the next section being loaded when you have completed the previous one, thus enhancing the game play. For further information please complete the coupon below.

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Rtn of Jedi 2
Sky Skipper
Spiderman
Super Cobra
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Mangia
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I want my Mom
Pizza Chef
Quest for Gold
Tally Ho
Tanks no Tanks

ACCESSORIES

We stock a wide range of accessories for the Atari VCS and 400/800 personal computers. The same accessories can be used on the Commodore VIC range of computers. The Wico range can also be used with the Texas Instruments computers on purchasing a special adaptor. To give you an idea of the range available, just take a look at the following list:

Trackball by Wico

LE STICK: A mercury filled joystick specially made for one handed operation, with thumb fire button.

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VIDEO COMMAND: With a tapered handle, this joystick is for one handed use. It has a directional control which is similar to a jet fighter joystick.

WICO RED-BALL: An arcade type joystick with a red ball handle, it features 2 fire button locations, one at the base and one on the stick. It comes supplied with 4 grip pads for easier table top use.

WICO STRAIGHT - STICK: The main feature of this joystick is its arcade style, bat handle grip. It also has 2 fire buttons. Four grip pads included for table top use.

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MATTEL INTELLIVISION

MATTEL INTELLIVISION: The Mattel games unit is a most versatile T.V. game which offers 3-D graphics quality for only £98. Each cartridge comes with 2 overlays which fit over the unique hand controller giving easy directions for game play. Using the handset's control disc, objects can be moved accurately in 16 directions giving a realistic simulation of lifelike movement. From 1st September 1983, the Mattel Intellivision T.V. Games Console will come with a **FREE VOICE SYNTHESIS MODULE**, normally priced at **£50.** This unit creates high quality synthesised male and female voices as part of the game play on certain cartridges.

NEW MATTEL CARTRIDGE RELEASES: Why not complete the coupon below and join the Silica Mattel Owners Club and receive our **FREE** news bulletins and 16 page catalogues detailing new Mattel releases. There will soon be over ninety cartridges available for the Mattel, and a small selection from these is listed below:

MATTEL: Arctic Squares, Burger Time, Buzz Bombers, Chess, Cloudy Mountain, Loco Motion, Mission X, Mystic Castle, Sharp Shot, Solar Sailor, Space Shuttle, Vectron, Winter Olympics. **ACTIVISION:** Happy Trails, Pitfall, Stampede. **C.B.S:** Blue Print, Carnival, Donkey Kong, Gorf, Mousetrap, Smurf, Solar Fox, Turbo, Venture, Wizard of Wor, Zaxxon. **IMAGIC:** Beezer, Dracula, Ice Trek, Nova Blast, Safecracker, Swords & Serpents, Tropical Trouble, White Water. **PARKER:** James Bond 007, Lord of the Rings, Popeye, Q-Bert, Spiderman, Star Wars, Super Cobra, Tutankham.

COMPUTER KEYBOARD: In July/August 1983, Mattel will be launching their new £89, 49-key computer keyboard attachment called 'Lucky' which is fully programmable and has microsoft basic built in. It will transform your Master Component into a home computer. The adaptor also accepts a 6 note polyphonic music synthesiser and full size 49-key piano keyboard that will make learning music as easy as playing games.

MATTEL + VOICE – £85.22 + VAT = £98.00

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VIDEO GAME CLUB

In a fast moving market like video games, it is difficult to keep up to date with all the developments that take place. With new programmes and accessories being introduced at a fast rate by several different manufacturers, it is impossible to get all the information you require from one manufacturer alone. It is for this reason, that we have set up owners clubs for the more popular video games and home computers, to keep you fully up to date with what is going on with your particular machine. As far as we know, Silica Shop are the only company to offer such clubs, but that is not surprising since we are the specialists. We currently have **FREE** clubs for the **Atari VCS, Atari 400/800** home computers, and **Mattel Intellivision.** Soon we will have clubs for **Colecovision, Aquarius** and **Vectrex.** So if you own one of these machines, fill in the coupon opposite, and we will enrol you **FREE OF CHARGE** in the club relevant to your computer or video game.

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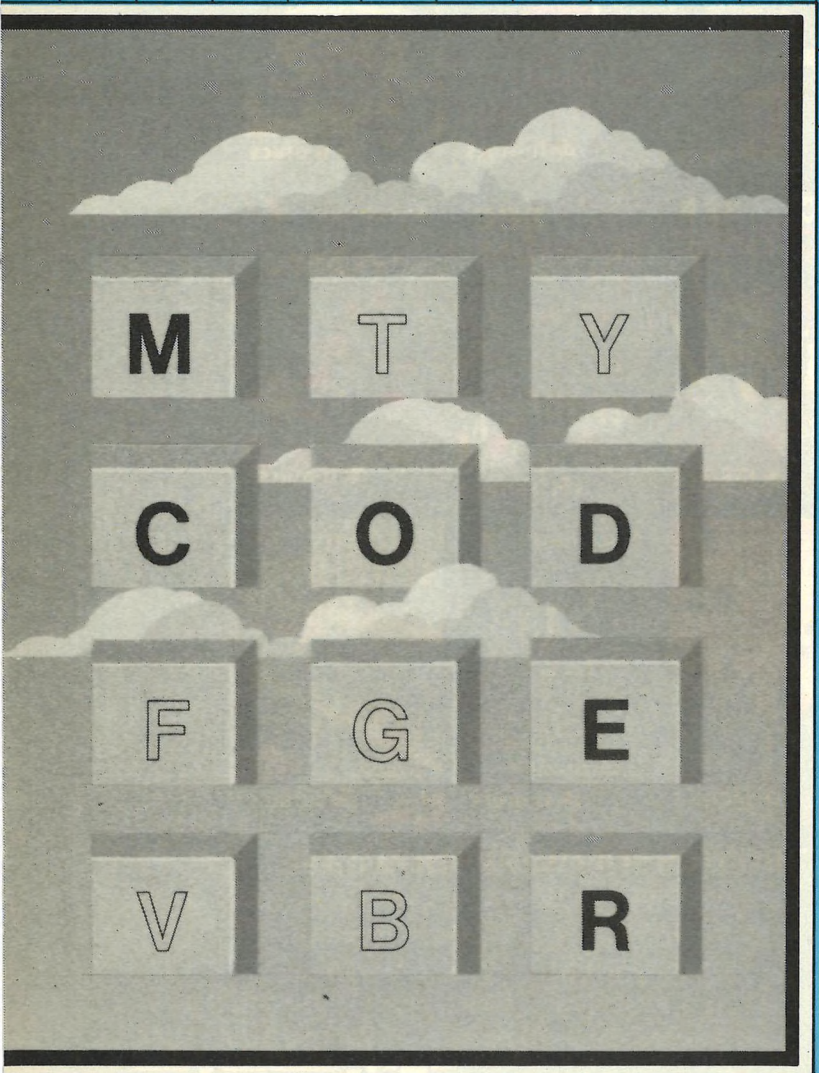
PSS....THE FUTURE MAKERS INTRODUCE

M CODER II

The ultimate integer basic compiler for the 48k Spectrum and 16k ZX81 Instantly turns your basic into machine code at the touch of a key!



After the huge success of M Coder (THE original compiler for the ZX81 and Spectrum) we have gone one stage further and improved it to make programming even easier!!

M CODER II now handles STRINGS (NOT string arrays) as well as 95% of all integer basic, and we have made it *even* easier to use.

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ENGLAND

Assembler/Disassembler ORIC-1

The assembler follows standard 6502 conventions and has proved very reliable while in continual use by Durell Software. Features include the following:

Generally	*List File*	*Pseudo-Op*
Auto line numbering	LIST	EQUATE
Six character labels	DELETE	BYTE
Updatable list-file	LLIST	DBYTE
Maths on operands	ALTER	WORD
Syntax checking	INSERT	TEXT
Output to printer	END/STOP	BLOCK

The disassembler also allows output to either screen or line-printer. The tape comes complete with comprehensive instructions. *£6.95*

Harrier Attack ORIC-1 and SPECTRUM

Pure machine-code, super-fast, action-packed, highly addictive arcade-style game requiring great skill. The harrier takes-off from an aircraft-carrier and flies over seaborne defences to attack enemy installations on a nearby island. The harrier may fly faster, slower, higher or lower, and has bombs and rocket fire with which to protect itself and make its own attack. If it flies too high it is detected by enemy jet-fighters (which it may counter-attack) – so it needs to hug the mountainous terrain which also varies with every new game. But the island is heavily defended by anti-aircraft rockets and tanks, which again the harrier may counter-attack or try to fly through. A tally is kept of fuel, bombs and rockets, plus player score and high score. Finally the harrier must make its bomb-run over the enemy base before returning to its own carrier. *£6.95*

Starfighter ORIC-1 (48K only)

You are in command of a galactic defence vessel travelling through time and space to attack and destroy intruding aliens. At long range this is carried-out on your computer scanner which displays stars in the local quadrant, with passing planets, space stations, time-gates, and of course the aliens which may strike in packs or singly, scattering anti-matter mines around your ship. You may counter-attack the aliens with your photon torpedoes, or if you move-in close enough switch over to manual and visual control to chase the fleeing alien and blast him with your phasors. See the star-scape spin relative to your ship's manoeuvres, but watch-out for the alien mines whizzing past. You will need to conserve energy carefully to get back to the refuelling points, and then the time-gates to the other quadrants. Weapons, shield and energy status are all monitored throughout this pure machine code game, which may be set to nine levels of skill. *£6.95*

Lunar Lander/Asteroids ORIC-1

Aimed at the newcomer to BASIC and/or the Oric-1, these exciting and enjoyable games are also easy to learn from, being short, simple and clearly written. Each is followed-up by a second version where every line of the BASIC is explained in an English REMark statement. These games also give a useful guide to the Oric's screen attributes. *£5.95*

Price includes postage, packing and VAT. Overseas customers please add £1 extra for postage outside UK.

Dambuster LYNX

Can you fly your bombers through the enemy flak to make your drop from the right height, speed and distance so that your bouncing bomb finally sinks just behind the dam? This is a game that demands both skill and timing; but more than that it also helps teach you to write games for yourself, as every line of the BASIC program is explained in English in two follow-up versions of the game. Features include:

Dambusters' theme tune
Three planes and three dams
Bomber flies higher, lower, faster or slower
Random anti-aircraft fire
Bomb bounces relative to height and speed of drop
Dam crumbles and water floods through
Player score plus high score *£6.95*

Jungle Troubles SPECTRUM

Pure machine code with super cartoon graphics. This original and witty game is set in the depths of the African jungle. First you must direct your man to collect an axe and cross a nearby river via stepping stones that protect him from a lurking crocodile. Then he must climb a ladder to the next level, where he has to fell a number of trees in his path. As he does this a marauding ape appears from the left of the screen and steals his axe! So back to the start for another axe and more problems with the crocodile! And the ape! Having hacked a path through the forest he may climb another ladder to level three where he has to leap a pit of flames by grabbing a swinging rope. Will he ever escape back to the city? Can he jump the chasm that suddenly opens before him just as he is about to reach home? A highly amusing game with delightful graphics suited to all members of the family – but very frustrating and addictive. *£6.95*

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NEW

E **The Golden Apple**

48K Spectrum
You must set out on a quest to find the 'Golden Apple'. On your journey you will pass through mansions, travel overseas and onto an island, hunting your treasure.

ZX Spectrum Adventures £6.95
ZX 81 Adventures £5.95

All these games are instant-response machine code programs. Adventures B, C and D include cassette save routines.

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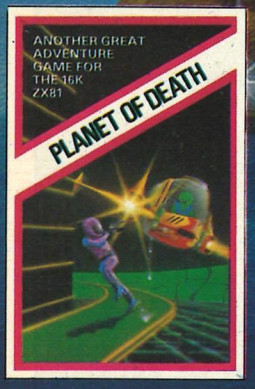
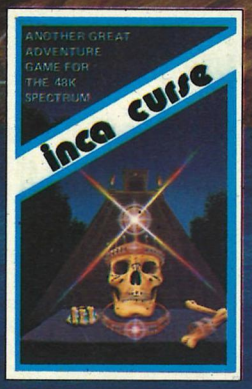
A



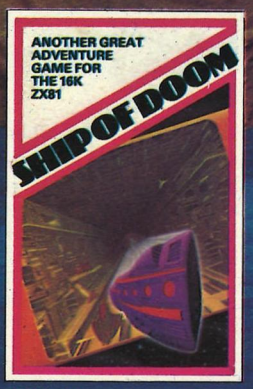
16/48K ZX/Spectrum
16K ZX81
You find yourself stranded on a strange alien planet. Your aim is to escape by finding your captured space craft. But beware of the little green man who may get to you!

B



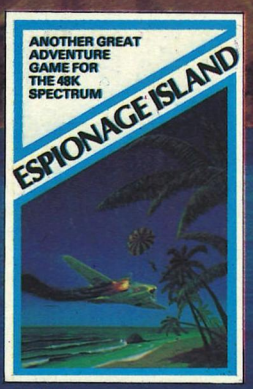
48K Spectrum
16K ZX81
You are in the middle of a South American jungle when you stumble across a strange Inca temple. Enter it to collect treasure and then try to return. But beware don't let greed be your downfall.

C



48K Spectrum
16K ZX81
While on a reconnaisance mission you are drawn to an alien cruiser on a humanoid slave mission. Try to escape from aggressive aliens, luscious androids and drunken barmen. Your only help is Fred the friendly android.

D



48K Spectrum
16K ZX81
You have to survive an engine failure while flying over an apparently uninhabitated island in the South Atlantic. Use your wits to harass the enemy, but treat the beautiful native women with respect, to escape from the island and return to an allies aircraft carrier.

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*Tick, delete or complete as applicable.

WARNING: These programs are sold according to ARTIC COMPUTING LTD's terms of trade and conditions of sale. Copies of which are availabe on request.

(continued from page 159)
this, entering 16514 as the start address then type in all the code as in listing 2. When you have done that, type Stop and run the code loader again, entering the start address for listing 3. Do this for all the machine code routines.

The delete the code loader and enter the Basic part of the program — listing 6. You may then Run the program.

The master program calls the other three routines and returns to Basic. By calling the master program over and over from Basic, the action is continuous.

Basic program notes.

1 to 4	contains the machine code
5	sets up initial length of worm
7 to 14	sets up obstacles
20 to 24	sets up display
90 to 96	stores location of base on screen into 16507 and 16508
110	puts base on screen
115	puts worm on screen
120	calls machine code and checks if 1 is pressed
125	loops round
130	shows reaction to key 1
135 to 140	sees if worm has landed
150	increases size of worm
160	starts next level
200 to 230	game over.

When you run the program several obstacles should appear. Then a border is printed and a one-segment worm appears at the top of the screen. This will start to move, descending one line when it hits an obstacle.

Your base at the bottom of the screen is moved right and left with I and T. Key 0 fires a missile. You must try and destroy the worm before it hits the ground.

If you do, press 1 and hold it down until the computer reacts. You will then move to the next level with a two-segment worm and more obstacles.

You can shoot most obstacles though some are indestructible. If the worm lands, you will have to hold down key 1 until the computer reacts and then the game is over.

The worm will not more into your missile from the side. You must shoot it from underneath. Sometimes the worm splits into many parts, making it very difficult to destroy, but you must cope as best you can.

Listing 1.

```
9000 PRINT "START ADDRESS?"
9010 INPUT A
9020 FOR F=A TO 4E4
9030 INPUT P
9040 POKE F,P
9050 SCROLL
9060 PRINT F,P
9070 NEXT F
```

Listing 2.

```
16514:17 33 0 42 12
16519:64 35 126 254 25
16524:200 254 8 40 7
16529:254 136 40 32 195
16534:136 64 54 0 35
16539:126 254 0 32 5
16544:54 8 195 136 64
16549:25 43 126 254 0
16554:32 5 54 136 195
16559:136 64 237 82 24
16564:247 54 0 43 126
16569:254 0 32 5 54
16574:136 195 136 64 25
16579:35 126 254 0 32
16584:5 54 8 195 136
16589:64 237 82 24 247
```

Listing 3.

```
16613:17 66 0 42 123
16618:64 58 37 64 254
16623:255 200 254 239 32
16628:9 237 82 126 254
16633:14 200 54 14 201
16638:254 223 32 18 54
16643:0 35 126 254 0
16648:32 7 54 38 237
16653:99 123 64 201 43
16658:24 246 254 251 32
16663:248 54 0 43 126
16668:254 0 32 7 54
16673:38 237 99 123 64
16678:201 35 24 246
```

Listing 4.

```
16715:17 33 0 42 12
16720:64 35 126 254 25
16725:200 254 14 32 247
16730:54 0 237 82 126
16735:254 131 40 6 254
16740:0 32 6 54 14
16745:25 195 81 65 254
16750:8 40 14 254 136
16755:40 10 254 149 32
16760:2 24 239 54 0
16765:24 234 54 149 24
16770:230
```

Listing 5.

```
16793:6 10 205 130 64
16798:205 229 64 205 75
16803:65 16 245 201 61
```

Listing 6.

```
   5 LET A$="▓"
   7 FOR N=1 TO 3
   8 PRINT AT RND*16,RND*25;"
"( TO INT (RND*6)+1)
   9 LET P=RND*30
  10 PRINT AT RND*13,P;("" AND
LEN A$=1)+("" AND LEN A$>1)
  11 FOR M=1 TO RND*4
  12 PRINT TAB P;"
   "(INT (RND*LEN A$)+1)
  13 NEXT M
  14 NEXT N
  20 PRINT AT 21,0;"
";CHR$ (LEN A$+156);"
"
  21 PRINT AT 0,0;"
"
  22 FOR N=1 TO 20
  23 PRINT AT N,0;"";TAB 30;"
"
  24 NEXT N
  30 IF LEN A$>1 THEN GOTO 115
  90 LET A=PEEK 16396+256*PEEK 1
6397+673
  95 POKE 16508,INT (A/256)
  96 POKE 16507,A-256*PEEK 16508
 110 POKE A,38
 115 PRINT AT 1,10;A$
 120 IF USR 16793 THEN IF INKEY$
="1" THEN GOTO 130
 125 GOTO 120
 130 PRINT AT 21,0;"
"
 135 FOR N=PEEK 16396+256*PEEK 1
6397+660 TO PEEK 16396+256*PEEK
16397+693
 140 IF PEEK N=8 OR PEEK N=136 T
HEN GOTO 200
 145 NEXT N
 150 LET A$=A$+"▓"
 160 GOTO 7
 200 CLS
 210 PRINT "YOU REACHED LEVEL ";
CHR$ (LEN A$+28)
 215 PRINT ,,,,,,"PRESS NEWLINE
FOR NEXT GAME"
 220 INPUT I$
 225 CLS
 230 RUN
9000 FOR F=16793 TO 4E4
9010 PRINT F,PEEK F
9030 NEXT F
```

Metronome

C Makepeace,
Bristol.

DRAGON

THIS PROGRAM IS INTENDED to replace the metronome you had to pawn to pay for your Dragon. It provides a menu of 12 tempos and their approximate frequency in beats per minute.

It permits regular stressing of every nth beat, if required. The beat of the metronome can be speeded up or slowed down using the left and right arrow keys while it is running. Any alteration in beat is shown and the tempo name is altered when the beat equates the frequency as displayed on the menu. While the metronome is running a graphic display of an arm swings — flicks — from side to side in rhythm.

The metronome can be halted by pressing the space-bar during which pause it can be restored by pressing the space-bar again or returned to the menu by pressing another key.

The metronome sounds more like a tooting oboe than a clockwork mechanism. Metronome is 2.7K long and easily shrunk by pruning out the Rems. All Gosubs branch to the subroutines proper and not the Rems.

```
5 REM FOR £ READ HASH CHARACTER
10 ' ************************
20 '        METRONOME
30 '   (C) C. MAKEPEACE
40 '************************
50 GOSUB450 'INITIALISE
60 '************************
70 'MENU
80 '************************
90 CLS
100 GOSUB 590 'TITLE
110 PRINT
120 FOR A=1 TO 12STEP2
130 PRINTUSING"££)%        %£££ ££)%        %£££";A,F$(A
),T(A),A+1,F$(A+1),T(A)
140 NEXTA
150 GOSUB 640'INSTRUCTIONS
160 PRINT
170 INPUT"  ENTER TEMPO NO. (1 TO 12)";B$
180 B=VAL(B$):IF B<1 OR B>12 THEN 150
190 BM=T(B)
200 CLS:PRINT@259,T$(B)" AT ";BM;"BEATS/MIN."
210 PRINT@323,"AFTER HOW MANY BEATS DO YOU ","   WANT
A STRESS (0 OR MORE)";:INPUT ISTRES$:ISTRESS=VAL(IS$)
220 '************************
230 '        DISPLAY
240 '************************
```

(continued on page 171)

Why the BBC Micro? It might be fairer to let someone else answer that question.

"The BBC Microcomputers are the limousines of home computers. The graphics are probably the best of any machine in this class. You are paying for a smart machine which would not disgrace the home of a professional." *Video World, Feb. '83.*

"Its design has given the BBC Micro an unrivalled potential for business, educational and serious home applications. It has been equipped to function as the heart of a system which can be expanded to suit its owner's need." *Which Micro & Software Review, Feb. '83.*

"The most attractive and exciting feature of the BBC Microcomputer is its enormous potential for expansion which will allow a highly expansive system to be built-up." *Deborah Carruthers, Which Micro, June '82.*

"They (the graphics) are tremendously exciting, and they are one of the features that make this machine stand out head and shoulders above everything else that is available in the market place at this time."
Dave Futcher, Educational Computing, May '82.

"It is expandable and has a powerful BASIC. It has superb sound and graphics, the software is readily available and the price is right."
Mr. A. D. Alles, a BBC Micro owner from Hampshire.

"The basics are easy to follow. My wife has developed a program for teaching our daughter French vocabulary. Our daughter uses it mainly for games and simple programming."
Dr. A. Yarwood, a BBC Micro owner from Co. Durham.

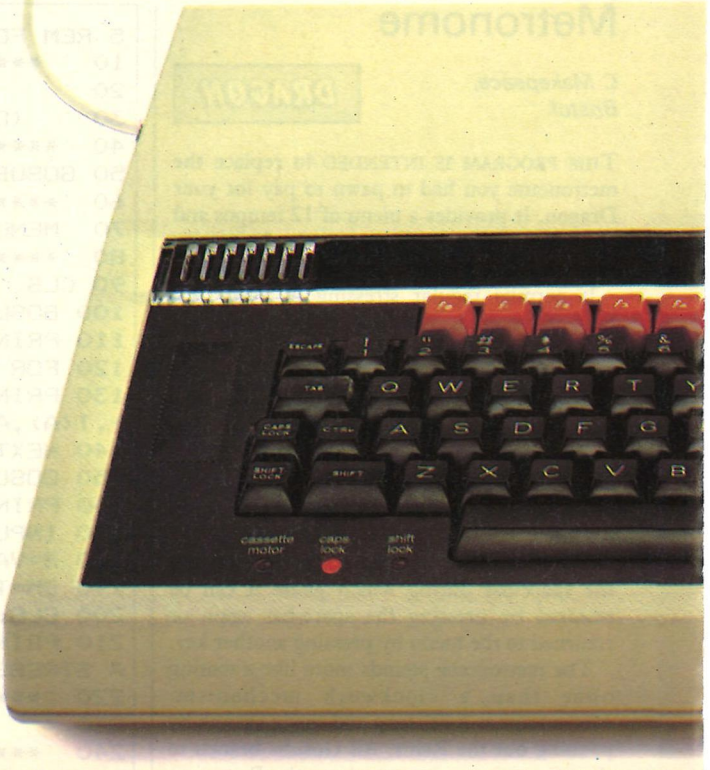
"It is a very powerful computer. My husband has written his own data base. I have been writing programs and programming games. Even the children have written small programs."
Mrs. A. M. Thomas, a BBC Micro owner from Devon.

"No other computer can offer such ease of use when dealing with complex sound effects."
Which Micro, June '82.

"It isn't often a journalist can sit down to write about a computer with the certain knowledge that he has never seen a nicer machine."
Guy Kewney, Personal Computer World, Dec. '82.

"It has got huge potential. Besides playing the games, the whole family are learning basic programming."
Mr. P. S. Green, a BBC Micro owner from Staffordshire.

"Everything possible seems to have been done to ensure that this is not a 'dead end' machine..."
Paul Beverley, Personal Computer World, July '82.



Perhaps we could just add that the BBC Micro is the machine which was chosen to be at the heart of the BBC's massive Computer Literacy Project.

It is also the machine which, having won the Department of Industry's blessing, will account for over 80% of the computers bought by British schools this year.

And now for some facts about the machine itself.

The BBC Micro is light, compact and, with a conventional electric typewriter keyboard, easy to get the feel of.

It can be loaded from virtually any cassette recorder. And there is a wealth of ready-made programs available covering games, education and business subjects.

The BBC Micro uses BBC BASIC, a sophisticated version of the most popular computer language.

However, as your confidence and fluency grow, it can be adapted to switch to other languages.

It can also become a word processor, with the facility to link with a second processor for high-powered business use.

A disc drive unit can also be added. And with an adaptor, the BBC Micro is the first micro to be able to pick up programs from the Micronet–Prestel system. Another adaptor converts your TV into a Teletext receiver, with further ability to download programs.

All this for only £399.

The most sophisticated version of the BBC Micro, the Model B, is only £399. The basic Model A is £299. (Both come with a "Welcome cassette" and comprehensive introductory manual.)

They are both available from John Lewis, selected branches of Boots or local stockists.

Alternatively, if you would like to order a BBC Micro B with your credit card, or if you want the address of your nearest stockist, just phone 01-200 0200.

Or, you can buy a Model B by sending off the order form below to: BBC Microcomputers, c/o Vector Marketing, Denington Estate, Wellingborough, Northants.

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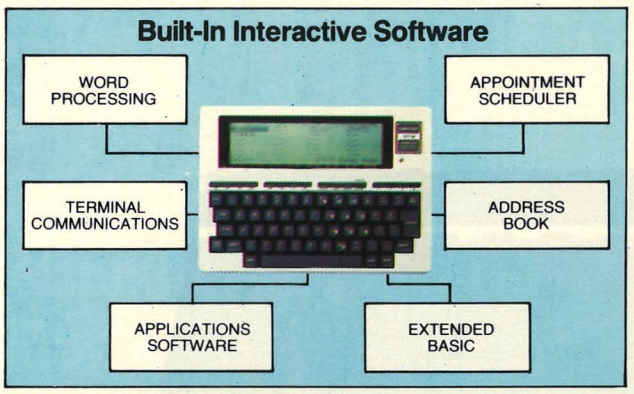

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(continued from page 167)

```
250 CLS:GOSUB590 'TITLE
260 GOSUB640 'INSTRUCTIONS REMINDER
270 GOSUB 710 'TEMPO
280 GOSUB760  'BEAT
290 TIMER=0
300 C$=INKEY$:IF C$<>"" THEN380
310 IF TIMER<BEAT THEN 300 ELSE STRESS=ST+1:TIMER=0:IF
 STRESS=ISTRESS THEN DU=DU+2:ST=0
320 GOSUB 950
330 SOUND PI,DU:DU=MD
340 GOTO300
350 '************************
360 ' ALTER TEMPO & STOP METRONOME
370 '************************
380 IFC$=CHR$(B) OR C$=CHR$(9) THEN GOSUB 820
390 IF C$=" " THEN GOSUB910
400 GOTO 300
410 END
420 '************************
430 'INITIALISATION
440 '************************
450 DIMT$(13),F$(13),T(13)
460 FORA=1TO13:READ T$(A),T(A)
470 IFLEN(T$(A))>9 THEN F$(A)=LEFT$(T$(A),2)+"'"+RIGHT
$(T$(A),6) ELSE F$(A)=T$(A)
480 NEXT A
490 DATAGRAVE,40,LENTO,42,LARGO,44,LARGHETTO,48,ADAGIO
,52,ANDANTE,60,MODERATO,80,ALLEGRETTO,99,ALLEGRO,116,V
IVACE,126,PRESTO,144,PRESTISSIMO,184,DUMMY,999:'TO ALL
OW FASTER TEMPI SANS CRASHING!
500 PITCH=100
510 MDURATION=1:DURATION=1
520 M1=172:M1$=CHR$(159)+"   "
530 M2=205:M2$=CHR$(134)+" "
540 M3=172:M3$="   "+CHR$(159)
550 M4=205:M4$=" "+CHR$(137)
560 '************************
570 'TITLE
580 '************************
590 PRINT@43,"METRONOME
600 RETURN
610 '************************
620 'INSTRUCTIONS
630 '************************
640 PRINT@322,"TO SLOW IT DOWN,PRESS'<-'KEY
650 PRINT@354,"TO SPEED IT UP,PRESS'->'KEY
660 PRINT@388,"PRESS spacebar TO PAUSE"
670 RETURN
680 '************************
690 ' TEMPO
700 '************************
710 PRINT@263,T$(B)
720 RETURN
730 '************************
740 ' BEAT
750 '************************
760 PRINT@276,BM
770 BEAT=INT(3000/BM)
780 RETURN
790 '************************
800 ' ALTER DISPLAY OF TEMPO & BEAT
810 '************************
820 IFC$=CHR$(9)THEN BM=BM+1
830 IFC$=CHR$(B) THEN BM=BM-1
840 IFBM=>T(B+1) THENB=B+1:GOSUB710
850 IF BM=<T(B-1) THEN B=B-1: GOSUB 710
860 GOSUB760
870 RETURN
880 '************************
890 ' PAUSE
900 '************************
910 PRINT@322,,,"  PRESS spacebar TO CONTINUE"," PRESS
 enter TO RETURN TO TABLE"," "
920 C$=INKEY$:IF C$="" THEN 920 ELSE IF C$=" "THEN GOS
UB 640: RETURN
930 GOTO 70
940 '************************
950 '      GRAPHICS
960 '************************
970 IF FL=0 THEN PRINT@M1,M1$:PRINT@M2,M2$:FL=1: ELSE
PRINT@M3,M3$:PRINT@M4,M4$:FL=0
980 RETURN
990 END
```

Instant command

A D Robinson,
Wath-on-Dearne,
South Yorkshire.

SPECTRUM

WHEN USING COMPILERS or disassemblers, or when developing a Basic program, it is often necessary to repeatedly make the same command. For example,

RAND USR 40000, SAVE "DEMO"

This can be very monotonous. This program listing for the 16K or 48K Spectrum enables the user to define a specific key or shifted key to give this command instantly.

The command to be defined is entered as line 1 of the program and is then edited and a Rem statement is inserted at the beginning. It can be changed as and when necessary.

Enter either the 16K or 48K listing, Save it, then Run it. When the machine code has been entered the program will ask for the code of the trigger key. This can be entered as a number from the list of codes at the back of the Spectrum manual or by entering, for example, Code"Z". Obviously choose a key that will not be needed. The program will then execute New and disappear, but the routine is now working.

Now type in

1 PRINT "This is an Example"

Press enter, the edit the line and inset the Rem statement before the word print. Now press enter again. To test the program press the chosen trigger key/keys and line 1 will be recreated at the bottom of the screen as a direct command and will be executed. It is best to stick to single statements in line 1 as multi-statement lines sometimes produce a syntax-error.

Another use for the routine is to prevent the accidental pressing of the New key. Enter 230 as the trigger code, enter 1 Rem Goto 9999, the line 9999 as Input 2$: IF 2$="Yes" then New. If the New key is then pressed, the program will check to see if you really mean it. To return to normal and switch off the defined key facility, simply type

RAND USR 65100 (32319 for 16K)

The program works by altering the interrupt mode of the Spectrum so that every 1/50 second it calls our machine-code routine. This routine looks at the system variable Last K and, if it is the trigger key, it jumps to the routine to change this. The program starts with the byte after the Rem statement and enters this into Last K.

It then sets bit 5 of system variable flags to fool the machine into thinking a new key has been pressed. A pointer is then incremented so that, on the next interrupt, the following byte is entered, and it keeps on doing this until the Enter character is found to indicate the end of the line. The pointer is then reset.

Remember to switch the routine off before overwriting any of the code used by the program.

```
  1 REM PRINT "16K Example"
  10 CLEAR 32318: PRINT AT 10,10
;"STAND BY"
  20 DATA 62,62,237,86,237,71,20
1,0,0,0
  30 DATA 62,40,237,71,237,94,33
,208,92,34,90,126,201,0,0,0,0,
0
  40 DATA 255,243,245,229,42,90,
126,125,254,208,32,8,33,8,92,126
,254,95,32,34,42,90,126,126,35,3
4,90,126,33,8,92,119,58,59,92,20
3,239,33,59,92,119,58,8,92,254,1
3,32,5,33,208,92,34,90,126,225,2
41,251,201
  50 FOR a=32319 TO 32405: READ
b: POKE a,b: NEXT a
  60 CLS : PRINT "CODE of trigge
r key ?"
  70 INPUT z: POKE 32365,z
  80 RANDOMIZE USR 32329: NEW
  81 REM RANDOMIZE USR 32319 TO
STOP

  1 REM PRINT "This is an examp
le"
  10 CLEAR 65099: PRINT AT 10,10
;"STAND BY"
  20 DATA 62,62,237,86,237,71,20
1,0,0,0
  30 DATA 62,9,237,71,237,94,33,
208,92,34,103,254,201,0,0,0,0,0,
0
  40 DATA 255,243,245,229,42,103
,254,125,254,208,32,8,33,8,92,12
6,254,95,32,34,42,103,254,126,35
,34,103,254,33,8,92,119,58,59,92
,203,239,33,59,92,119,58,8,92,25
4,13,32,5,33,206,92,34,103,254,2
25,241,251,201
  50 FOR a=65100 TO 65186: READ
b: POKE a,b: NEXT a
  60 CLS : PRINT AT 10,4;"CODE o
f trigger key ?"
  70 INPUT z: POKE 65146,z
  80 RANDOMIZE USR 65110: NEW
```

Kippax Stock Market

Charles W Peel,
Leeds.

ATOM

KIPPAX MAY NOT BE the biggest village in England but it can now boast about this fun stock market game which bears its name. The game is ideal for gatherings of up to nine people. This limitation is only due to the presentation which is available on the Atom. I personally organise the party so that one person is the keyboard operator to interpret the wishes of individual players.

The initial screen introduces the market and the players are requested to determine the number of rounds they wish the game to consist of, and also their respective *nom de plumes* in the order they wish to play. Each *nom de plume* can be up to nine characters including any full stops or spaces.

The Atom then displays the current state of the market in respect of six commodities — gold, tin, silver, copper, lead and plastics. The details which follow are:

■ The actual quote for each commodity expressed in pence.

■ The realisable value of each share after deducting 10 percent for each sale.

■ The cost of each share after including the charge of 10 percent for each purchase.

Columns two and three are only expressed to three significant figures, so beware of rounding traps.

■ When the time is due — see column six — the shares will pay out dividends determined in a random manner from 20 to 120 pence per share. Catching the high dividends is the sure way to make your fortune and win the game.

■ The market makes available 999 shares in each commodity and this column informs you how many are available for purchase.

■ Each commodity is initially given a number which is determined by the number of players taking part. This indicates the time left to the next dividend pay out. This number is reset after a pay out so that you have to make a judgment — when to buy or sell.

The lower part of the screen then displays the state of the player whose turn it is to play.

(continued on page 173)

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(continued from page 171)

Displayed are the cash in hand initially set to £200, the number of shares of each commodity held and the potential worth of the player should he be able to sell all his holdings.

The final line displays action and this is where the transactions are entered. Each player is allowed up to four transactions per turn but only one of them may be a sale. The actions available are:

B — Buy
S — Sell
N — Next player please

after B or S the next character must be from the following:

G — Gold
T — Tin
S — Silver
C — Copper
L — Lead
P — Plastics

followed by the number of shares to buy or sell.

Beware. If you miscalculate, the Atom will display a cryptic remark and terminate your turn by calling up the next player. When the entry is complete press the space-bar and the Atom will revise your current state due to this action.

Ater each player's turn the current state of all players is displayed in the form of cash in hand and potential worth, as well as the number of rounds remaining in the game. This is important to watch because at the end of the game only the cash in hand is considered to determine the winner. Because only one sale may be made in any one round, if you do not sell your shares at the right time you may loose their value.

When all players have had an equal number of turns — that is the end of each round their names are sorted into the sequence of the cash in hand held. The potential value is also displayed. In this manner it is possible to judge your current performance against all the others. Best wishes for happy marketeering.

```
 10L=£82C0;E=£8200;F=£8218;G=£8230;B=£8260;T=£8248
 20M=£80;N=£81;O=£82;Q=£88;S=£83;H=£8B;R=£8A;DIMLL5
 30F.I=0TO5;LLI=£9000;N.I;P.$3$15$21;F.I=0TO1;P=£9000
 40E:LL0 JSR£FFE6;STAM;RTS
 50:LL4 ADC£84;STA£84;STAQ;LDA@0;ADC£85;STAC£85;STA£89;JMPLL3
 60:LL2 LDA£84;ASLA;STA£84;LDA£85;ROLA;STA£85;RTS
 70:LL1 LDA@0;STA£84;STA£85
 80:LL3 JSRLL2;STA£87;LDA£84;STA£86;JSRLL2;JSRLL2;LDA£84
 90 ADC£86;STA£84;LDA£85;ADC£87;STA£85
100:LL5 JSR£FFE3;CMP@13;BEQLL5;JSR£FE52;JSR£F87E
110 BCCLL4;RTS;]:N.I
120aP.$6$12;P."       KIPPAX STOCK MARKET"''
130IN."NO.OF ROUNDS TO END "Z;P.'
140IN."NO.OF PLAYERS "A;J=0;@=0;F.I=0TO A;H?I=I;N.I;I=0
150P.$12"       KIPPAX STOCK MARKET"'
160DOP."NAME OF PLAYER NO."(I+1);IN.$B;B=B+LENB+1;L!J=20000
170F.K=J+4TOJ+28 STEP4;L!K=0;N.K;J=K;I=I+1;U.I=A
180F.I=0TO20 STEP4;E!I=100;F!I=999;G!I=8*A;T!I=0;N.I
190D=0;B=£8260;@=4
200bP.$12"       KIPPAX STOCK MARKET"'
210P."           ACT BID OFF DIV BNK POS"
220P."gOLD     ";?0=0;GOS.j;P."tIN     ";?0=4;GOS.j
230P."sILVER   ";?0=8;GOS.j;P."cOPPER  ";?0=12;GOS.j
240P."lEAD     ";?0=16;GOS.j;P."PLASTICS";?0=20;GOS.j
250P." CURRENT ACCOUNT FOR "'"CASH IN HAND"'
260P."gOLD";DOP." ";U.C.=14;P."tIN"'
270P."sILVER";DOP." ";U.C.=14;P."cOPPER"'
280P."lEAD";DOP." ";U.C.=14;P."PLASTICS"'
290P."TOTAL ASSETS";DOP." ";U.C.=20;P.'"ACTION ";C=0;Y=0;G.h
300cLI.LL0;IF?M=CH"B";P."UY ";?N=?M;C=C+1;G.d
310IF?M=CH"S";P."ELL ";?N=?M;C=C+1;Y=Y+1;G.d
320IF?M=CH"N";P."EXT PLAYER";G.i
330P.$8" "$8;G.c
340dIFC>4;G.u
350IFY>1;G.t
360LI.LL0;IF?M=CH"G";P."OLD ";?0=0;G.e
370IF?M=CH"T";P."IN ";?0=4;G.e
380IF?M=CH"S";P."ILVER ";?0=8;G.e
390IF?M=CH"C";P."OPPER ";?0=12;G.e
400IF?M=CH"L";P."EAD ";?0=16;G.e
410IF?M=CH"P";P."LASTICS ";?0=20;G.e
420P.$8" "$8;G.d
430eLI.LL1;IF?N=CH"B";G.f
440IF(L!(D*32+(4+?0))-(256*(Q?1)+?Q))<0;G.v
450!S=((E!(?0))*(256*(Q?1)+?Q)*9)/10;G.9
460f!S=((E!(?0))*(256*(Q?1)+?Q)*11)/10
470IF(F!(?0)-(256*(Q?1)+?Q))<0;G.w
480IF!S>L!(D*32);G.x
490F!(?0)=(F!(?0))-(256*(Q?1)+?Q);L!(D*32)=(L!(D*32))-!S
500L!(D*32+(4+?0))=L!(D*32+(4+?0))+(256*(Q?1)+?Q);G.h
5109F!(?0)=(F!(?0))+(256*(Q?1)+?Q)
520L!(D*32+(4+?0))=(L!(D*32+(4+?0)))-(256*(Q?1)+?Q)
530L!(D*32)=(!S)+(L!(D*32))
540hF.I=0TO6;P.$11;N.;P.';DOP.$9;U.C.>20;P.$B;DOP." ";U.C.>30
550P.';DOP.$9;U.C.=13;J=L!(D*32);GOS.m;P.'
560DOP.$9;U.C.=9;P.L!(4+D*32);DOP.$9;U.C.=26;P.L!(8+D*32)
570P.';DOP.$9;U.C.=9;P.L!(12+D*32);DOP.$9;U.C.=26;P.L!(16+D*32)
580P.';DOP.$9;U.C.=9;P.L!(20+D*32);DOP.$9;U.C.=26;P.L!(24+D*32)
590P.';DOP.$9;U.C.=14;J=L!(D*32);GOS.n;GOS.m;P.'
600DOP.$9;U.C.=7;DOP." ";U.C.=25;P.$13;DOP.$9;U.C.>32;G.c
610iU=B;V=D;D=0;B=£8260;P.$12"TABLE OF CURRENT PLAYER VALUES"'
620DOP." ";U.C.=13;P."ASSETS"'
630DOP.$B;DOP." ";U.C.=12;J=L!(D*32);GOS.n;GOS.m;P.';B=B+LENB+1
640D=D+1;U.D=A;B=U;D=V;B=B+LENB+1;D=D+1;IFD=A:D=0;B=£8260
650GOS.r;LI.LL0;IFD=0A.Z<>1;GOS.o;GOS.r;LI.LL0;G.b
660IFD<>0;G.b
670GOS.o;P."THANK YOU FOR PLAYING"'
680IN."DO YOU WISH TO PLAY AGAIN"$B;IF?B=CH"Y";G.a
690E.
700jG!(?0)=G!(?0)-(A.R.%6+1);T!(?0)=0
710IFG!(?0)<0;T!(?0)=0-(20*(G!(?0)));G!(?0)=8*A;G.l
720kIFG!(?0)%5=0;E!(?0)=E!(?0)-2
730IFG!(?0)%5=1;E!(?0)=E!(?0)-1
740IFG!(?0)%5=3;E!(?0)=E!(?0)+1
750IFG!(?0)%5=4;E!(?0)=E!(?0)+2
760P.E!(?0),E!(?0)*9/10,E!(?0)*11/10,T!(?0),F!(?0),G!(?0);R.
770lI=0;DOL!(I*32)=L!(I*32)+((L!(I*32+(?0)+4))*(T!(?0)))
780I=I+1;U.I=A;G.k
790mP.(J/100);@=0;P.".";IF(J%100)<10;P."0"
800P.(J%100)"    ";@=4;R.
810nF.I=0TO20STEP4;J=J+(((L!(4+I+D*32))*(E!I)*90)/100);N.I;R.
820oP.$12"       BIG SPENDERS LEAGUE"'"NO.OF ROUNDS LEFT "
830D=0;Z=Z-1;P.Z';DOP." ";U.C.=12;P."CASH       TOTAL"'
840DO;J=L!(D*32);GOS.n;L!(D*32+28)=J;D=D+1;U.D=A;W=A-1
850DO;X=0;DO;IFL!((H?X)*32)<L!((H?(X+1))*32);GOS.9
860X=X+1;U.X=W;W=W-1;U.W=0;DO;B=£8260;IFH?W=0;G.P
870F.I=1TOH?W;B=B+LENB+1;N.I
880PP.$B;DOP." ";U.C.>9;J=L!((H?W)*32);GOS.m
890J=L!((H?W)*32+28);GOS.m;P.';W=W+1;U.W=A;D=0;B=£8260;R.
9009?R=H?X;H?X=H?(X+1);H?(X+1)=?R;R.
910rP.'"NEXT PLAYER - "$B'"PRESS SPACE BAR TO CONTINUE"';R.
920sF.I=0TO5;P.$11;N.I;P.';F.I=0TO2;DOP." ";U.C.>30;P.';N.I;R.
930tGOS.s;P."SORRY - ONLY ONE SALE ALLOWED";G.9
940uGOS.s;P."GREEDY - TOO MANY TRANSACTIONS";G.9
950vGOS.s;P."YOU HAVE ONLY",L!(D*32+(4+?0))" UNITS";G.9
960wGOS.s;P."ONLY"F!(?0)" UNITS AVAILABLE";G.9
970xGOS.s;P."YOU HAVEN'T GOT ENOUGH - SORRY"
980yF.I=0TO300;WAIT;N.I;G.i
```

Padcalc

B R Law,
Leicester.

ZX-81

PADCALC IS A general-purpose mathematical program that will allow up to five formulae to be entered for subsequent calculation. It is most useful when only a limited number of "what if?"-type calculations are required, and under these circumstances it is easier to set up than a spreadsheet program and the format is more readily understandable.

In general terms using Padcalc is the computer equivalent of paper and pencil because it works in the same way you would if working through a formula or series of formulae. It initially asks you to enter your formula containing all of its variables. When you have entered your last formula press Newline and it will list all the variables for which it requires you to enter values. You will notice that it does not ask for a variable if this has been calculated previously or if the same variable was used in a previous formula.

The cursor over the variable letter indicates that it is waiting for you to enter a value against this letter; when this is done it moves to the next variable. When the last variable is entered the results are automatically calculated and printed below the variables.

At this stage the cursor over the last variable letter begins to flash, indicating that you can now change the value of one of the variables. The cursor can be moved up and down in response to the cursor keys 6 and 7 and when key V is pressed a new value for the variable on which the cursor sits, can be entered.

Variables can continue to be changed in this manner until key C is pressed. A new set of results are then calculated and the result is printed adjacent to the first set. This process can be continued until four sets of variables and results are printed on the screen. Any further changes will result in the screen being cleared and the next set of results are printed down the first row.

A warning that this will happen is given at the bottom of the screen after four sets of results have been calculated. The following types of functions can be used in the formula: +, -, *, 1, **, E, Sin, Cos, Tan, Asn, Acs, Atn, Rnd, Int, Sqr, PI, Abs

There are, however, certain constraints that should be applied when entering a formula, and they are as follows.

No more than five formulae may be entered at any one time.

Variable names should be no more than two characters long and if numerics are included they should be put after an alphabetic character. For example, A1, V2 and so on.

When using trigonometric functions a single alphabetic character only can be used and any angle must be given a variable name. A numeric angle will not be accepted in a formula. For example Sin 30° should be entered as Sin A. The angle can then be entered as a variable.

All angle variables should be entered as

(continued on page 175)

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YC8

(continued from page 173)

decimal degrees. For example, Sin 30° 30' should be entered as Sin 30.5°.

All answers involving degrees are given in decimal form.

When using the functions Sin, Cos and Tan the variable which the function acts upon has initially to be multipled by $\pi/180$ to change degrees to radians. In cases where the variable has no brackets around it the $\pi/180$ is inserted immediately after the function by the program. When brackets are present $\pi/180$ is inserted inside the first bracket. Therefore, if brackets are required always put on an additional set. For example, Sin A; Sin (A×B); Sin ((A+B)).

Now an example to clarify the entry procedures. This example uses the program to calculate various features of a gear. The variables used are defined as follows:

PD = Pitch circle diameter
OD = Outside diameter
RD = Root diameter
TT = Tooth thickness
N = Number of teeth
DP = Diametrical pitch.

After loading the program using Load "Padcalc" you should receive a prompt asking for the first formula. Proceed as follows:

PD = N/DP ➔N/L
OD = PD + 2/DP ➔N/L
RD = OD − 2×2.25/DP ➔N/L
TT = 1.5708/DP ➔N/L ➔N/L.

The screen should now have a black cursor visible over the letter N. Now enter the value for N, for example 45 ➔N/L. The cursor jumps to DP so enter a value for this, for example, 11 ➔N/L. After this last entry the answers are automatically calculated and displayed against their respective variables.

After this either of the two variables can be changed by shifting the cursor using keys 6 or 7 then pressing key V and entering the new variable. To see the new results press C for recalculation. For example, 7 ➔V ➔15➔ N/L ➔ will recalculate the results with the number of teeth changed to 15.

```
   1 REM "PADCALC"
   4 FAST
   5 DIM M$(5,50)
   6 DIM F$(5,100)
   7 DIM A(5)
   8 LET V$=""
   9 LET A$=""
  10 LET F=0
  11 LET KV=0
  12 LET DP=3
  13 LET FL=0
  50 REM FORMULA ENTRY
  55 PRINT AT 21,0;"FORMULA? PRE
SS N/L TO FINISH"
  65 LET F=F+1
  70 INPUT M$(F)
  75 IF M$(F,1)=" " THEN GOTO 10
5
  80 LET F$(F)=M$(F)
  85 GOSUB 500
  90 PRINT AT F-1,0;M$(F)
  95 IF F=5 THEN GOTO 110
 100 GOTO 65
 105 LET F=F-1
 110 SLOW
 115 LET V1=LEN V$/2
 120 DIM W(LEN A$/2)
 125 DIM P(V1)
 130 DIM V(V1)
 135 PRINT AT F,0;"
                    "
 140 PRINT AT 21,0;"
                    "
 145 FOR X=1 TO V1
 150 LET P(X)=F+X
 155 PRINT AT P(X),0;V$((X*2)-1
TO X*2)+"="
 160 NEXT X
 165 PRINT "
                    "
 170 FOR Y=1 TO LEN A$/2
 175 LET W(Y)=P(X-1)+1+Y
 180 PRINT AT W(Y),0;A$((Y*2)-1
TO Y*2)+"="
 185 NEXT Y
 190 GOTO 600
 500 REM FORMULA ENCODE
 501 REM MAKE VARIABLES
         LOWER
 505 LET X=0
 510 LET X=X+1
 515 IF F$(F,X)=" " THEN GOTO 57
0
 517 IF CODE F$(F,X)>198 AND COD
E F$(F,X)<205 THEN GOSUB 700
 518 IF F$(F,X)="E" AND CODE F$(
F,X-(X<>1))>28 AND CODE F$(F,X-(
X<>1))<38 THEN GOTO 510
 520 IF CODE F$(F,X)>37 AND CODE
 F$(F,X)<64 THEN GOTO 530
 525 GOTO 510
 530 IF CODE F$(F,X+1)<28 OR COD
E F$(F,X+1)>63 THEN LET F$(F)=F$
(F,1 TO X)+" "+F$(F,X+1 TO )
 531 REM LOAD VARIABLES INTO
         END V$
 532 IF X=1 THEN GOTO 555
 533 IF V$="" THEN GOTO 542
 534 FOR Z=1 TO LEN V$*(LEN V$>=
LEN A$)+LEN A$*(LEN A$>LEN V$) S
TEP 2
 535 IF Z+1>LEN V$ THEN GOTO 540
 536 IF F$(F,X TO X+1)=V$(Z TO Z
+1) THEN GOTO 545
 538 IF Z+1>LEN A$ THEN GOTO 541
 540 IF F$(F,X TO X+1)=A$(Z TO Z
+1) THEN GOTO 545
 541 NEXT Z
 542 LET V$=V$+F$(F,X TO X+1)
 545 LET X=X+1
 550 GOTO 510
 555 LET A$=A$+F$(F,X TO X+1)
 560 GOTO 545
 565 REM
         [illegible]
 570 LET X=5
 575 LET F$(F)="A("+STR$ VAL "F"
+"("+F$(F,3 TO )
 580 LET X=X+1
 585 IF F$(F,X)=" " THEN RETURN
 587 IF F$(F,X)="E" AND CODE F$(
F,X-(X<>1))>28 AND CODE F$(F,X-(
X<>1))<38 THEN GOTO 580
 590 IF CODE F$(F,X)>37 AND CODE
 F$(F,X)<64 THEN GOTO 600
 595 GOTO 580
 600 LET Y=1
 605 IF Y>LEN A$ THEN GOTO 625
 610 IF F$(F,X TO X+1)=A$(Y TO Y
+1) THEN GOTO 645
 615 LET Y=Y+2
 620 GOTO 605
 625 LET K=1
 630 IF F$(F,X TO X+1)=V$(K TO K
+1) THEN GOTO 655
 635 LET K=K+2
 640 GOTO 630
 645 LET F$(F)=F$(F,1 TO X-1)+"A
("+STR$ ((VAL "Y"+1)/2)+")"+F$(F
,X+2 TO )
 650 GOTO 660
 655 LET F$(F)=F$(F,1 TO X-1)+"V
("+STR$ ((VAL "K"+1)/2)+")"+F$(F
,X+2 TO )
 660 LET X=X+4
 665 GOTO 580
 700 REM [illegible]
 705 IF CODE F$(F,X+1)<>16 THEN
GOTO 740
 710 IF CODE F$(F,X)>198 AND COD
E F$(F,X)<202 THEN GOTO 730
 715 LET F$(F)=F$(F,1 TO X-1)+"1
80/PI*"+F$(F,X TO )
 720 GOTO 765
 730 LET F$(F)=F$(F,1 TO X+1)+"P
I/180*"+F$(F,X+2 TO )
 735 GOTO 765
 740 IF CODE F$(F,X)>198 AND COD
E F$(F,X)<202 THEN GOTO 760
 745 LET F$(F)=F$(F,1 TO X-1)+"1
80/PI*"+F$(F,X TO )
 750 GOTO 765
 760 LET F$(F)=F$(F,1 TO X)+"(PI
/180*"+F$(F,X+1)+")"+F$(F,X+2 TO
)
 765 LET X=X+7
 770 RETURN
 800 REM INITIAL GOSUB
 805 LET P5=PEEK (16396)+PEEK (1
6397)*256+1
 810 LET PC=P5+((F+1)*33)
 815 LET X=1
 820 GOTO 845
 825 LET PP=PC
 830 IF FL=0 THEN GOSUB 1000
 835 GOSUB 3000
 840 POKE PP,PEEK (PP)-128
 845 POKE PC,PEEK (PC)+128
 850 GOTO 825
1000 REM INPUT VARIABLES
1005 IF X>V1 THEN GOTO 2000
1010 INPUT V(X)
1015 PRINT AT P(X),4;V(X)
1020 LET PC=PC+33
1021 IF X=V1 THEN LET PC=PC-33
1022 LET X=X+1
1025 GOTO 840
2000 REM CALCULATION
2002 LET FL=1
2005 FOR X=1 TO F
2010 LET A(X)=VAL F$(X,6 TO )
2015 PRINT AT W(X),4+KV;INT (A(X
)*(10**DP)+.5)/(10**DP)
2020 NEXT X
2022 LET KV=KV+7
2023 IF KV>=28 THEN PRINT AT 21,
0;"   NB:SCREEN TO CLEAR"
2025 RETURN
3000 REM CURSOR
3010 IF INKEY$="V" THEN GOTO 310
0
3015 IF INKEY$="C" THEN GOTO 320
0
3020 LET PC=PC+((INKEY$="6")*33)
*(PC-P5<>(F+V1)*33)-((INKEY$="7"
)*33)*(PC-P5<>(F+1)*33)
3025 RETURN
3100 REM CHANGE OF VARIABLE
3105 LET D=((PC-P5)/33)-F
3110 INPUT V(D)
3115 IF KV>=28 THEN GOSUB 4000
3120 PRINT AT P(D),4+KV;V(D)
3125 RETURN
3200 FOR X=1 TO V1
3205 PRINT AT P(X),4+KV;V(X)
3210 NEXT X
3215 GOTO 2000
4000 REM CLEAR SCREEN
4005 LET KV=0
4010 FOR X=F+1 TO W(F)
4015 IF X=P(V1)+1 THEN GOTO 4025
4020 PRINT AT X,3;"
                    "
4025 NEXT X
4030 PRINT AT 21,3;"
                    "
4050 RETURN
5000 SAVE "PADCALC"
5001 GOTO 1
```

Othello

A P Walrond,
Pitney,
Somerset.

BBC

THIS PROGRAM is Othello, also known as Reversi, and it runs on a Model B BBC Micro or a Model A upgraded to 32K.

The program plays a good strong game of Othello and has two extra features:

- You can swop colours at any point in the game.
- It contains a can't go check — if you think you cannot go, the computer will check. Operating instructions are given in the program.

The average time taken by the computer to make its move is 10 seconds.

A word of advice to beginners: aim for the sides, and the corners in particular.

```
  10 REM ***OTHELLO***
  20 REM By A.P.Walrond
  30 ON ERROR GOTO 370
  40 MODE7:PROCINSTRUC
  50 MODE5
  60 VDU19,0,1,0,0,0:VDU19,1,3,0,0,0:VDU19,2,0,0,0,0
  70 COLOUR130:CLS
  80 GCOL0,0
  90 *FX11,0
 100 MOVE800,1000:MOVE800,200
 110 PLOT85,0,1000:PLOT85,0,200
 120 GCOL0,3
 130 VDU5
 140 FOR I=0 TO 800 STEP 100:MOVE I,200:PLOT21,I,1000:IF I<800 MOVEI+15,190:PRI
NT CHR$(65+(1*(I/100)))
 150 NEXT I
 160 FOR I=200 TO 1000 STEP 100:MOVE 0,I:PLOT21,800,I:IF I<1000 MOVE 810,I+70:P
RINT STR$(I/100-1)
 170 NEXT I
 180 VDU4
 190 DRAW0,1000:DRAW0,200:DRAW 800,200:DRAW 800,1000
 200 DIM B%(7,7),P%(7,7),BIG%(4)
 210 FOR R=0 TO 7:FOR C=0 TO 7:READ P%(R,C):NEXT C:NEXT R
 220 DATA 32,2,16,16,16,16,2,32,2,0,1,1,1,1,0,2,16,1,8,4,4,8,1,16,16,1,4,2,2,4,
1,16,16,1,4,2,2,4,1,16,16,1,8,4,4,8,1,16,2,0,1,1,1,1,0,2,32,2,16,16,16,16,2,32
 230 B%(3,3)=2:B%(3,4)=3:B%(4,3)=3:B%(4,4)=2
 240 CCM=0:YCM=0:YT%=2:CT%=2:YC=3:CC=2
 250 PROCUPDATE
 260 COLOUR1
```

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(continued from page 175)

```
  270 PRINTTAB(0,27);"Shall I go first? ";:A$=GET$:PRINT A$
  280 REPEAT:IF A$="N" THEN A$="":PROCYMOVE:GOSUB320
  290 PROCCMOVE:GOSUB320
  300 PROCYMOVE:GOSUB320
  310 UNTIL FALSE
  320 IF YT%+CT%<64 AND (YCM+CCM)<>2 AND YT%<>0 AND CT%<>0 THEN RETURN
  330 MODE7
  340 IF YT%>CT% THEN A$=" YOU WIN!!":COL=130:ELSE IF CT%>YT% THEN A$="  I WIN!"
:COL=133:ELSE A$="IT'S A DRAW!":COL=132
  350 PROCWIN
  360 A=INKEY(100):PRINTTAB(10,18)"Another game?":A$=GET$:IF A$="Y" THEN RUN
  370 *FX12,0
  380 END
  390 DEFPROCUPDATE
  400 P%=0
  410 FOR Y%=1000 TO 300 STEP-100
  420 FOR X%=0 TO 700 STEP 100
  430 IF POINT(X%+50,Y%-50)=B%(Y%/100-3,X%/100) THEN 460
  440 GCOL0,B%(Y%/100-3,X%/100)
  450 MOVEX%+50,Y%-5:MOVEX%+10,Y%-50:PLOT85,X%+50,Y%-95:MOVEX%+90,Y%-50:PLOT85,X
%+50,Y%-5
  460 P%=P%+1
  470 NEXT X%:NEXT Y%
  480 ENDPROC
  490 DEFPROCYMOVE
  500 YCM=0
  510 *FX15,1
  520 COLOUR1:PRINTTAB(0,27);"Row number?";SPC(29):R%=GET-49:COLOUR0:IF R%>=-1 A
ND R%<=8 THEN PRINTTAB(12,27);CHR$(R%+49) ELSE VDU7:GOTO520
  530 IF R%=-1 THEN 610
  540 IF R%=8 THEN PROCSWAP:ENDPROC
  550 COLOUR1:PRINTTAB(0,28);"Column letter?";SPC(25):C%=ASC(GET$)-65:COLOUR0:IF
 (C%>=0 AND C%<=7) OR C%=-17 OR C%=-8 THEN PRINTTAB(14,28);CHR$(C%+65) ELSE VDU7
:GOTO550
  560 IF C%=-17 THEN 610
  570 IF C%=-8 THEN PROCSWAP:ENDPROC
  580 PROCCHANGE(YC,CC,1,R%,C%)
  590 IF ER=1 THEN PRINTTAB(0,27);SPC(40):VDU7:GOTO 520
  600 ENDPROC
  610 COLOUR0:PRINTTAB(0,27)"O.K. I'll check.";SPC(25)
  620 FOR R=0 TO 7:FOR C=0 TO 7:PROCCHANGE(YC,CC,0,R,C):IF ER=0 THEN C=8:R=8:GOT
O640 ELSE NEXT C:NEXT R
  630 PRINTTAB(0,28)"O.K. My go!!":VDU7:A=GET(160):YCM=1:ENDPROC
  640 NEXT C:NEXT R
  650 PRINTTAB(0,28)"Yes you can!...":VDU7:A=INKEY(160):GOTO 520
  660 DEFPROCCHANGE(YCOL,OPCOL,FILL,R%,C%)
  670 YR%=R%:YC%=C%:T%=0:ER=0
  680 IF B%(R%,C%)<>0 THEN ER=1:ENDPROC
  690 DATA 1,0,1,1,0,1,-1,1,-1,0,-1,-1,0,-1,1,-1
  700 RESTORE 690
  710 FOR CHECK=1 TO 8:R%=YR%:C%=YC%:READ RC%,CC%:GOSUB 760:NEXT CHECK
  720 IF T%=0 THEN ER=1:ENDPROC
  730 IF YCOL=CC AND FILL=1 THEN CT%=CT%+T%+1:YT%=YT%-T%
  740 IF YCOL=YC AND FILL=1 THEN YT%=YT%+T%+1:CT%=CT%-T%
  750 ENDPROC
  760 IF R%+RC%<0 OR R%+RC%>7 OR C%+CC%<0 OR C%+CC%>7 THEN RETURN
  770 IF B%(R%+RC%,C%+CC%)<>OPCOL THEN RETURN
  780 N%=0
  790 REPEAT
  800 R%=R%+RC%:C%=C%+CC%:N%=N%+1
  810 UNTIL B%(R%,C%)=YCOL OR B%(R%,C%)=0 OR C%+CC%<0 OR C%+CC%>7 OR R%+RC%<0 OR
 R%+RC%>7
  820 IF B%(R%,C%)<>YCOL THEN N%=0 ELSE T%=T%+N%-1
  830 IF FILL<>1 OR N%=0 THEN RETURN
  840 REPEAT
  850 R%=R%-RC%:C%=C%-CC%:N%=N%-1:B%(R%,C%)=YCOL
  860 UNTIL N%=0
  870 PROCUPDATE
  880 RETURN
  890 DEFPROCCMOVE
  900 CCM=0
  910 COLOUR0:PRINTTAB(0,27);"Thinking...          please wait.       "
  920 BIG%(0)=0:BIG%(1)=0
  930 FOR ROW%=0 TO 7:FOR COL%=0 TO 7
  940 PROCCHANGE(CC,YC,0,ROW%,COL%)
  950 IF T%=0 THEN 1000
  960 PT%=P%(ROW%,COL%)
  970 IF PT%>2 THEN 990
  980 ON (PT%+1) GOSUB 1040,1080,1150
  990 IF T%+PT%>BIG%(0)+BIG%(1) THEN BIG%(0)=T%:BIG%(1)=PT%:BIG%(2)=ROW%:BIG%(3)
=COL%
 1000 NEXT COL%:NEXT ROW%
 1010 IF BIG%(0)=0 THEN VDU7:PRINTTAB(0,27);"I can't move!";SPC(27):A=INKEY(160)
:ENDPROC
 1020 FOR I=1 TO 3:B%(BIG%(2),BIG%(3))=CC:PROCUPDATE:B%(BIG%(2),BIG%(3))=0:PROCU
PDATE:NEXT I:PROCCHANGE(CC,YC,1,BIG%(2),BIG%(3))
 1030 ENDPROC
 1040 IF ROW%<3 THEN R=0 ELSE R=7
 1050 IF COL%<3 THEN C=0 ELSE C=7
 1060 IF B%(R,C)<>0 THEN PT%=8
 1070 RETURN
 1080 PT%=6
 1090 IF ROW%>1 AND ROW%<6 THEN RM=0 ELSE IF ROW%<3 THEN RM=-1 ELSE RM=1
 1100 IF COL%>1 AND COL%<6 THEN CM=0 ELSE IF COL%<3 THEN CM=-1 ELSE CM=1
 1110 IF B%(ROW%+RM,COL%+CM)<>CC THEN PT%=PT%-2
 1120 IF B%(ROW%+RM+CM,COL%+CM+RM)<>CC THEN PT%=PT%-2
 1130 IF B%(ROW%+RM-CM,COL%+CM-RM)<>CC THEN PT%=PT%-2
 1140 RETURN
 1150 IF ROW%=1 THEN RM=-1 ELSE IF ROW%=6 THEN RM=1 ELSE RM=0
 1160 IF COL%=1 THEN CM=-1 ELSE IF COL%=6 THEN CM=1 ELSE CM=0
 1170 IF B%(ROW%+RM,COL%+CM)=0 THEN PT%=0
 1180 IF B%(ROW%+RM,COL%+CM)=CC THEN PT%=16
 1190 RETURN
 1200 DEFPROCWIN
 1210 PRINTTAB(8,10);CHR$(136);CHR$(COL);CHR$(141);A$
 1220 PRINTTAB(8);CHR$(136);CHR$(COL);CHR$(141);A$
 1230 ENDPROC
 1240 DEFPROCINSTRUC
 1250 PRINTTAB(12);CHR$(130);CHR$(141);"OTHELLO";TAB(12);CHR$(130);CHR$(141);"OT
HELLO";TAB(11);CHR$(130);CHR$(141);"*********"
 1260 PRINT:PRINT CHR$(132);"Instructions:"
 1270 PRINT:PRINT"You must try to beat the computer at    this game called 'OTHE
LLO'.The program  incorporates several special features  to make the game easie
r and more        interesting."
 1280 PRINT:PRINT"You start off as WHITE,but you may      change colour during y
our turn simply   by typing '9'."
 1290 PRINT:PRINT"If you think you can't go,type '0' and  the computer will chec
k.If it finds thatyou can go,it will tell you,otherwise  it takes its move."
 1300 PRINT'CHR$(134);"Press any key to continue"
 1310 A=GET:ENDPROC
 1320 DEFPROCSWAP
 1330 COLOUR0:PRINTTAB(0,27);"O.K.-Colours swaped.  -You are now ";
 1340 IF YC=3 THEN PRINT"BLACK" ELSE PRINT"WHITE"
 1350 SW=YC:YC=CC:CC=SW:SW=YT%:YT%=CT%:CT%=SW
 1360 VDU7:A=INKEY(200):ENDPROC
```

Filecard

Steve Jeynes,
Barry,
South Glamorgan.

SPECTRUM

FILECARD IS a database-type program for storing information on the 48K Spectrum. The program is written in Basic which has obvious limitations but is still able to offer all the usual features associated with database programs, plus a couple of extra features I have put in myself.

I have tried to make the display on the screen as interesting and attractive as possible. I have come across some database programs before but found them very boring, especially in the display format, and as a result they never captured my interest. It was because of this that I wrote the Filecard program.

Most of the database programs I had come across held the data as a single or double line of information, held in one string

DIM A$ (100,32)

which allows for 100 files each with a length of 32 characters per file. This would be displayed as a single line of information across the screen from left to right. With the Filecard program the data is displayed as eight lines each with 15 characters — a total of 120 characters per file — and is placed as a block of information in the centre of the screen.

I have tried to create a card-type display rather than a couple of lines of data across the screen. I had to sacrifice the number of files that would be available to the user in order to make the most of the Spectrum's colour, and add the extra features which are available in the Filecard program. There are, in fact, only 250 files available but this number could be increased slightly by not using the colours of the Spectrum. I think that if you have the colour facility you should make the most of it. Database-type programs will come into their own once the long-awaited Microdrive is made available, as it will mean very fast retrieval of data which has been stored outside the computer.

I used a single string array A$, but I made it a three-dimensional array. This way allows for a number of different entries per file ie.,

DIM A$ (250,8,15)

which gives us 250 files each with eight lines containing 15 characters each. With this type of array the format for the display could be made to resemble that of a small filecard, see figure 1.

```
FILECARD NO.  1

NAME-      FRED BLOGGS
DETAILS-   16 ARTHUR ST
           BLOWDOWN
           COST £175.00
           DEPOSIT £17.50
           BALANCE £157.50
           INTEREST  10%
           12 AT £14.44
```

Figure 1.

The features of this program are:

Terminate. This option allows you to stop the program. If you exit the program and then decide to continue, providing the program is still in the computer, you can type Goto 330, which is the start of the menu routine, and the files which were in the computer will still be there.

Add a filecard. This allows the input of filecards through the keyboard. Each line is entered as a string of 15 characters, a For-Next loop does this eight times — the number of lines per file. There is also a facility to correct any mistakes that are made during the entry of files. After all the files have been entered they are sorted into alphabetical order.

Search a filecard. You simply enter the name of the file you wish to see and the computer will search through all the file names until it finds the one you chose. It will then print the whole file on the screen.

Save filecards. This option allows the user to Save files on to cassette. Data is Saved twice.

Load filecards. This allows the user to load files from cassette.

List filenames. This option takes the first line of every file and prints in a list. Each file is in alphabetical order and is numbered. There is the optional output to printer in this routine.

List filecards. This option displays each file, in a complete form, on the screen. The files are in alphabetical order and each is numbered. There is also the optional output to the printer if required.

Scan filecards. This allows the user to browse through the filecards at his own pace. When entering this routine the first filecard to be displayed is number 1, by pressing any key except P or Q you can move on to the next file. The P key allows you to move backwards down the list. The Q key will return the user to the menu. All the filecards are displayed in their complete form.

Alter filecards. This allows the user to alter a filecard at any time. The filecard is displayed on the screen; all the user has to do is position

(continued on page 179)

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OXO
BOGGLES
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SKI-JUMP
HANGMAN
OLD BONES
THIN ICE

MAZE EATER
ORBITTER
MOTORWAY
FORCE-FIELD
NIM
TUNNEL ESCAPE
BARREL JUMP
CANNONBALL BATTLE
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(continued from page 177)

the small cursor alongside the line they wish to change. Changing that line is a simple task.

All these options are easy to use and all the instructions needed are printed on the screen for you.

The lack of files is one of the bad points about the program. Another bad point is the time it takes to sort. This is because every time a swap has to take place, all the information which is held in eight lines has to be swapped as well, making it a very long process. The routine uses a For/Next loop to transfer the file in the sort but it does take its time.

Program notes.
POKE 23658,8 forces caps lock on
POKE 23609,50 is the keyboard bleep
POKE 23692,0 will scroll the screen
There are no Rem statements in order to allow maximum storage area. A$ is the dimensioned array for holding the filecards

```
 10 PAPER 0: INK 7: BORDER 0: CLS
 20 PAPER 0: INK 7: BORDER 0:
 30 PRINT INK 6; BRIGHT 1;AT 10, 11;" F
ILECARD 1 ";AT 19,0;"By Steve Jeynes";AT
 21,0;"PRESS ANY KEY TO CONTINUE"
 40 POKE 23609,50: POKE 23658,8
 50 LET F$="FILECARD NO. ": LET N$="NAM
E-   ": LET H$="DETAILS-": LET L$="MAX.
15 CHR$ PER LINE": LET E$="MAX. 8 LINES
PER CARD": LET G$="ENTRY NO. "
 60 DIM a$(250,8,15): LET E=1
 70 PAUSE 0: CLS
 80 GO TO 330
 90 REM INPUT FILES
 100 PRINT INK 7; BRIGHT 1;AT 0,9;"FILEC
ARD ENTRY"
 110 GO SUB 820: GO SUB 910
 120 PRINT INK 5; BRIGHT 1;AT 3,23;E
 130 PRINT AT 19,0;"
            ";AT 20,0;"
               ";AT 21,0;"
               "
 140 PRINT INK 7; BRIGHT 1;AT 20,3;G$
 150 FOR J=1 TO 8
 160 PRINT INK 7; BRIGHT 1;AT 20,12;J
 170 PRINT BRIGHT 1; INK 7;AT J+4,13;">>
"
 180 INPUT A$(E,J,1 TO 15)
 190 IF A$(E,J)="Q1                " THEN L
ET A$(E,J)="                ": GO TO 240
 200 PRINT INK 6; BRIGHT 1;AT J+4,13;A$(
E,J)(1 TO LEN A$(E,J)): NEXT J
 210 BEEP .5,50: LET F=E: GO SUB 930
 220 BEEP .10,10: LET E=E+1: IF E>200 TH
EN GO TO 240
 230 PAUSE 50: FOR J=1 TO 8: PRINT AT J+
4,13;"                ": NEXT J: GO TO 12
0
 240 REM SORT
 250 CLS : PRINT INK 4; BRIGHT 1; INVERS
E 1;AT 0,6;"STAND BY- SORTING"
 260 FOR B=1 TO E-1: FOR C=B+1 TO E-1
 270 IF A$(B,1)<=A$(C,1) THEN GO TO 300
 280 FOR J=1 TO 8
 290 LET D$=A$(B,J): LET A$(B,J)=A$(C,J)
: LET A$(C,J)=D$: NEXT J
 300 NEXT C
 310 NEXT B
 320 PRINT INK 5; BRIGHT 1; INVERSE 1;AT
 0,6;" SORTING COMPLETE ": FOR H=-20 TO
20: BEEP .010,H: NEXT H: CLS
 330 REM MENU
 340 PRINT INK 6; BRIGHT 1;AT 0,11;"OPTI
ONS";AT 2,7;"1 - TERMINATE";AT 4,7;"2 -
ADD A FILECARD";AT 6,7;"3 - SEARCH A FIL
ECARD";AT 8,7;"4 - SAVE FILECARDS";AT 10
,7;"5 - LOAD FILECARDS";AT 12,7;"6 - LIS
T FILE NAMES";AT 14,7;"7 - LIST FILECARD
S";AT 16,7;"8 - SCAN FILECARDS";AT 18,7;
"9 - ALTER FILECARDS"
 350 IF INKEY$="" THEN GO TO 350
 360 IF INKEY$="1" THEN CLS : PRINT INK
6; BRIGHT 1;AT 10,0;"DO YOU WISH TO STOP
 THE PROGRAM?": INPUT BRIGHT 1;"ENTER Y
/ N";B$: IF B$="Y" THEN STOP
 370 IF INKEY$="2" THEN CLS : GO TO 090
 380 IF INKEY$="3" THEN CLS : GO TO 460
 390 IF INKEY$="4" THEN CLS : GO TO 530
 400 IF INKEY$="5" THEN CLS : GO TO 570
 410 IF INKEY$="6" THEN CLS : GO TO 600
 420 IF INKEY$="7" THEN CLS : GO TO 1180
 430 IF INKEY$="8" THEN CLS : GO SUB 108
0
 440 IF INKEY$="9" THEN CLS : GO TO 740
 450 CLS : GO TO 330
 460 REM SEARCH
 470 INPUT BRIGHT 1;"HARD COPY?  (Y/N)";
B$
 480 CLS : PRINT BRIGHT 1; INK 1; PAPER
7;AT 10,2;"ENTER FILE TO BE SEARCHED FOR
": LET F=E
 490 INPUT Z$
 500 IF Z$=A$(F,1)( TO LEN Z$) THEN CLS
: PRINT BRIGHT 1; INK 1; PAPER 6;AT 1,10
;"FILE FOUND": GO SUB 820: PRINT INK 5;
BRIGHT 1;AT 3,23;F: FOR J=1 TO 8: PRINT
INK 7;AT J+4,13;A$(F,J): NEXT J: PAUSE 4
00: IF B$="Y" THEN COPY : CLS : GO TO 33
0
 510 IF F>1 THEN LET F=F-1: GO TO 500
 520 CLS : PRINT INK 2; PAPER 7; INVERSE
 1;AT 21,7;"FILE SEARCH COMPLETE": GO TO
330
 530 REM SAVE DATA
 540 FOR V=1 TO 2: CLS
 550 PRINT INK 7; BRIGHT 1;AT 4,9;"SAVIN
G DATA A$": SAVE "DATA" DATA A$(): NEXT V
 560 CLS : PRINT INK 7; BRIGHT 1;AT 4,9;
"SAVE COMPLETE": PAUSE 100: CLS : GO TO
330
 570 REM LOAD DATA A$
 580 CLS : PRINT INK 7; BRIGHT 1;AT 0,7;
"LOADING DATA A$": LOAD "DATA" DATA A$()
 590 CLS : GO TO 330
 600 REM LIST
 610 PRINT INK 7; BRIGHT 1;AT 7,0;"PRESS
 ""P"" KEY TO HOLD LIST       PRESS ANY K
EY TO CONTINUE LIST  NO HOLD WHEN PRINTE
R IS USED"
 620 LET E=1: INPUT BRIGHT 1;"HARD COPY?
 (Y/N)";B$: CLS
 630 IF A$(E,1)="                  " THEN G
O TO 710
 640 IF INKEY$="P" THEN PAUSE 0
 650 PRINT INK 7; BRIGHT 1;A$(E,1); INK
5; INVERSE 1;''"NO.-";E;CHR$ 94: PRINT
 660 IF INKEY$="P" THEN PAUSE 0
 670 IF B$="Y" THEN LPRINT A$(E,1); INVE
RSE 1;''"NO.-";E;CHR$ 94: LPRINT
 680 IF INKEY$="P" THEN PAUSE 0
 690 LET E=E+1: PAUSE 30: POKE 23692,0:
GO TO 630
 700 PAUSE 200: CLS : GO TO 330
 710 PRINT FLASH 1; INK 6; PAPER 1;"LIST
 COMPLETE"
 720 IF B$="Y" THEN LPRINT "LIST COMPLET
E"
 730 PAUSE 100: CLS : GO TO 330
 740 REM ALTER FILE
 750 CLS : INPUT BRIGHT 1;"ENTER FILE NU
MBER TO BE CHANGED ";F: GO SUB 820: GO S
UB 910
 760 PRINT INK 7; BRIGHT 1;AT 3,23;F: FO
R J=1 TO 8: PRINT INK 6; BRIGHT 1;AT J+4
,13;A$(F,J): NEXT J
 770 GO SUB 970
 780 INPUT BRIGHT 1;"ALTER ANOTHER FILE?
  (Y/N)";B$
 790 IF B$="Y" THEN GO TO 750
 800 CLS : GO TO 240
 810 RUN
 820 REM DRAW
 830 INK 5: PAPER 0: BRIGHT 1
 840 PLOT 28,68: DRAW 200,0: DRAW 0,88
 850 PLOT 28,156: DRAW 0,-88
 860 PLOT 228,156: DRAW -200,0
 870 PLOT 28,140: DRAW 200,0
 880 PLOT 100,140: DRAW 0,-72
 890 PRINT AT 3,9;F$;AT 5,4;N$;AT 6,4;H$
 900 RETURN
 910 PRINT INK 7; BRIGHT 1;AT 15,3;L$;AT
 14,3;E$
 920 RETURN
 930 INPUT BRIGHT 1;"IS THIS FILE CORREC
T?  (Y/N)    ";B$
 940 IF B$="Y" THEN RETURN
 950 IF B$="N" THEN GO TO 970
 960 GO TO 930
 970 PRINT INK 7; BRIGHT 1;AT 19,0;"PRES
S ""A"" TO SELECT INCORRECT   ENTRY WITH
 << CURSOR"'"PRESS ""P"" WHEN SELECTED"
;AT 5,30;"<<"
 980 LET J=1
 990 LET S$=INKEY$: IF S$="" THEN GO TO
990
1000 IF S$="P" THEN GO TO 1050
1010 IF S$="A" THEN LET J=J+1
1020 IF J=9 THEN PRINT AT J+3,30;"  ": L
ET J=1
1030 PRINT INK 7; BRIGHT 1;AT J+4,30;"<<
";AT J+3,30;"  "
1040 PAUSE 100: GO TO 990
1050 INPUT BRIGHT 1;"INPUT CORRECT ENTRY
              ";A$(F,J)
1060 PRINT INK 6; BRIGHT 1;AT J+4,13;A$(
F,J);AT J+4,30;"  "
1070 GO TO 930
1080 LET F=1
1090 GO SUB 820: PRINT INK 7; BRIGHT 1;A
T 18,0;"PRESS ""P"" TO SCAN PREVIOUS FIL
E PRESS ""Q"" TO RETURN TO MENU      PRES
S ANY OTHER KEY TO CONTINUE"
1100 IF F<1 THEN LET F=1
1110 PRINT INK 7; BRIGHT 1;AT 3,23;F;" "
: FOR J=1 TO 8: PRINT AT J+4,13;A$(F,J):
 NEXT J
1120 IF INKEY$="" THEN GO TO 1120
1130 IF INKEY$="P" THEN LET F=F-1: GO TO
 1100
1140 IF INKEY$="Q" THEN CLS : GO TO 330
1150 IF INKEY$<>"P" AND INKEY$<>"Q" THEN
 LET F=F+1
1160 IF F=E THEN CLS : PRINT INK 7; BRIG
HT 1;AT 1,10;"NO MORE FILES": PAUSE 100:
 CLS : GO TO 330
1170 GO TO 1100
1180 INPUT BRIGHT 1;"HARD COPY?  (Y/N)";
B$
1190 LET F=1: GO SUB 820
1200 FOR J=1 TO 8
1210 PRINT INK 7; BRIGHT 1;AT 3,23;F;AT
J+4,13;A$(F,J)
1220 NEXT J
1230 PAUSE 100
1240 IF B$="Y" THEN COPY
1250 IF F=E-1 THEN GO TO 1280
1260 LET F=F+1
1270 GO TO 1200
1280 CLS : PRINT INK 7;-BRIGHT 1;AT 3,10
;"LIST COMPLETE": PAUSE 100: CLS : GO TO
 330
```

Renumber

G M Jackson,
Osmkirk,
Lancashire.

ORIC

THIS IS A useful renumber program for the Oric 1. Oric owners should find the way it utilises some of the machine's addressing features informative. Although it is written in Basic it is surprisingly fast.

The program only renumbers program lines and does not alter the number after Gosubs and Gotos. To use it simply tag it on the end of the program you want to renumber and enter Goto 63900.

```
10 REM THE PROGRAM USES THE FOLLOWING VARIABLES:
20 REM DEEK(£9A) = THE START OF BASIC PROGRAM
30 REM DEEK(£9C) = END OF BASIC PROGRAM = E
40 REM A = ADDRESS OF BASIC PROGRAM LINE = DEEK(A)
50 REM N = LINE NUMBER
60 REM S (INITIALLY) = START LINE NUMBER FROM
70 REM I = INCREMENT
63900 REM FOR £ READ HASH CHARACTER
63905 PRINT CHR$(12);SPC(10)"RENUMBER":PRINT
63910 INPUT "COMMENCE LINE NUMBERS FROM";S
63915 IF S<1 OR S>63899 THEN GOTO 63910
63920 INPUT "INCREMENT BY";I
63925 IF I<1 OR I>100 THEN GOTO 63920
63930 A=DEEK(£9A):E=DEEK(£9C)
63935 N=DEEK(A+2)
63940 IF N>=63900 OR A>E THEN PRINT"RENUMBER COMPLETED":END
63945 DOKEA+2,S:S=S+I:A=DEEK(A)
63950 GOTO 63935
```

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COMPETITION CORNER

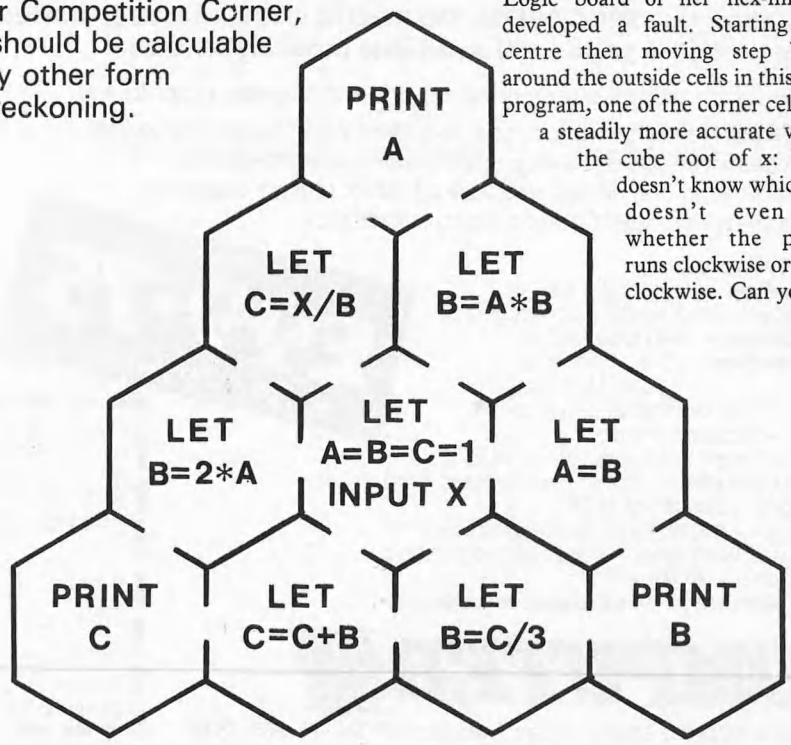
A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in September. The name of the winner, the solution, and a competition report will be published in the November, 1983 issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

HONEYCOMB

BY ANTHONY ROBERTS

THE QUEEN OF the hive-ship Sting has another problem — the Honeycomb Logic board of her hex-micro has developed a fault. Starting in the centre then moving step by step around the outside cells in this cellular program, one of the corner cells prints a steadily more accurate value for the cube root of x: But she doesn't know which — she doesn't even know whether the program runs clockwise or counter clockwise. Can you help?



COMPETITION RESULTS AND WINNERS

"I WOULD LIKE AN Electron to enter my orbit because . . ." was the way July's competition sentence began. Most competitors drew their inspiration from physics. The electron, it appears carries a negative charge and attracts particles with a positive charge. Almost a hundred people were struck by this fact and started their entries with "I am positive . . .". B. Moxley said simply, "I am positive I would be attracted to it", while N Langley confessed "I am positively unstable without it". The winning entry came from R Warriner, 59 Reeds Lane, Moreton, Wirral, who wrote "I am positively excited by it current potential".

Other variations on the nuclear theme were R Munday's "I don't want to Bohr people with my Atom".

Competitors had clearly ransacked their physics textbooks for appropriate puns, as in R Booth's "coming with no charge would give it a unique charm" and E Jupp's "it would bring me out of my shell by a quantum leap". The most ingenious of these perhaps was "I.C. I can't resistor current micro: watt ohms not ampered without one" from N Reckert.

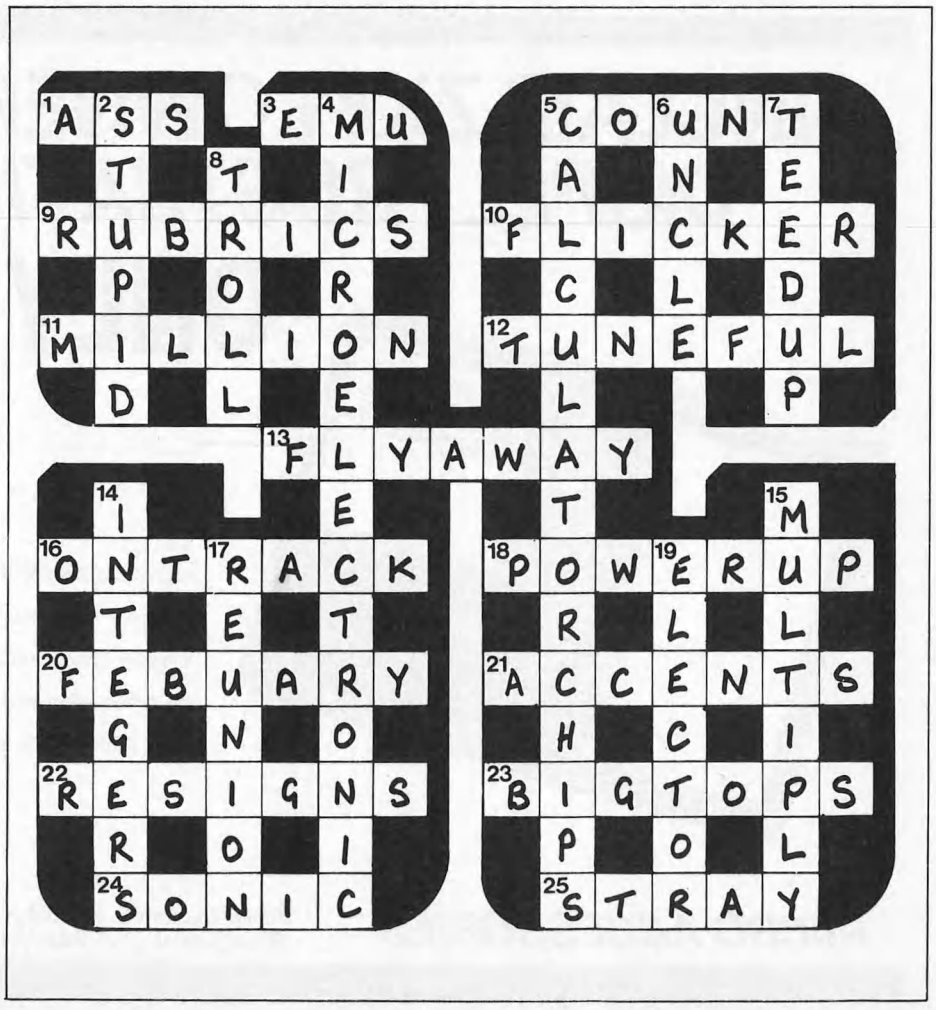
Leptons, protons, positrons, neutrons, quarks all made an appearance but particle of the month was undoubtedly the ion. "Ionestly find myself attracted by its high positive potential" quipped M Cutler. And in common with several others S Baker reported "I have had my ion it for some time".

Only a few entries managed to escape from the world of particles and electricity. P Mullen suggested "its a dream-piece rainbow warrior to harpoon the wailing industry" and B Turner offered "If win <> Electron then repeat Goto arcade until cashflow = 0".

The Trinary Tribulation puzzle was almost too easy for most competitors. Finding a solution only requires that you convert the decimal number 282506 to its trinary equivalent, 1121000112012. If you now consult the table of alphabetic codes you can translate four groups of three "trits" to give the answer, NINE.

We awarded the £15 book token to A Caslaw, 31 Purton Stoke, Swindon, Wilts, who submitted the following program to run on a ZX81:

```
10 LET A$=""
20 INPUT X
30 LET Y=X/27
40 LET X=INT Y
50 LET B$=CHR$ (27*(Y-X)+37)
60 LET A$=B$+A$
70 IF X>0 THEN GOTO 30
80 PRINT A$
```



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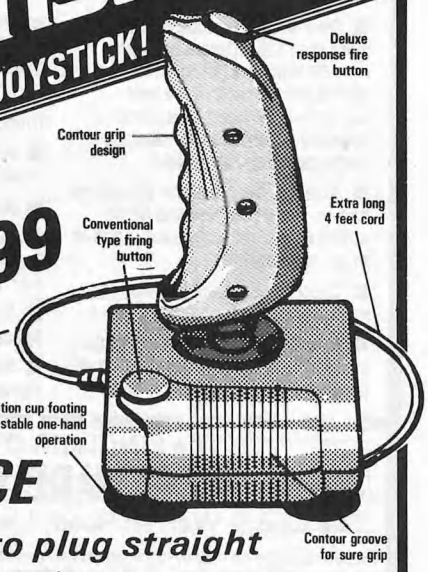

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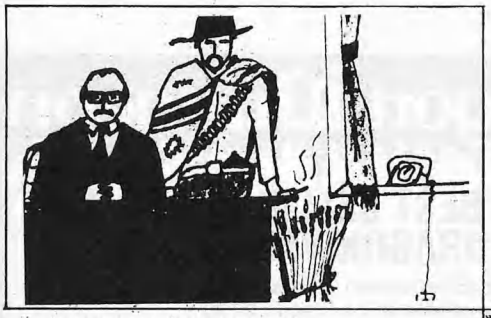

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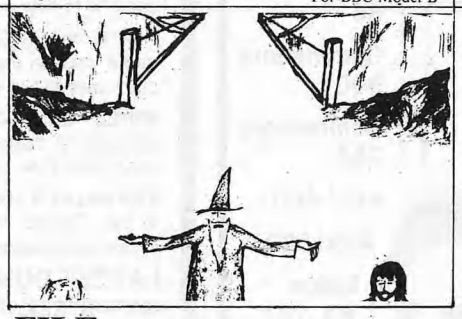

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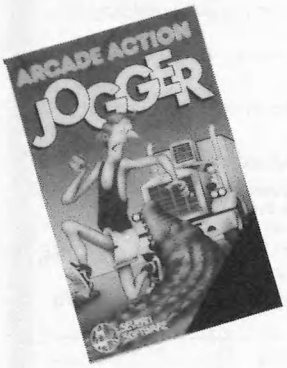

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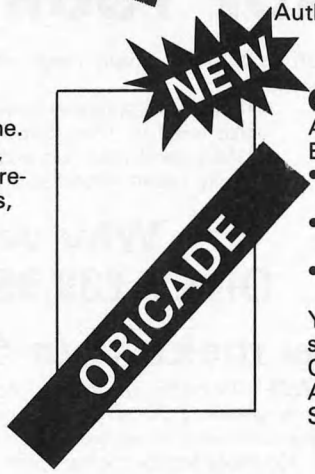

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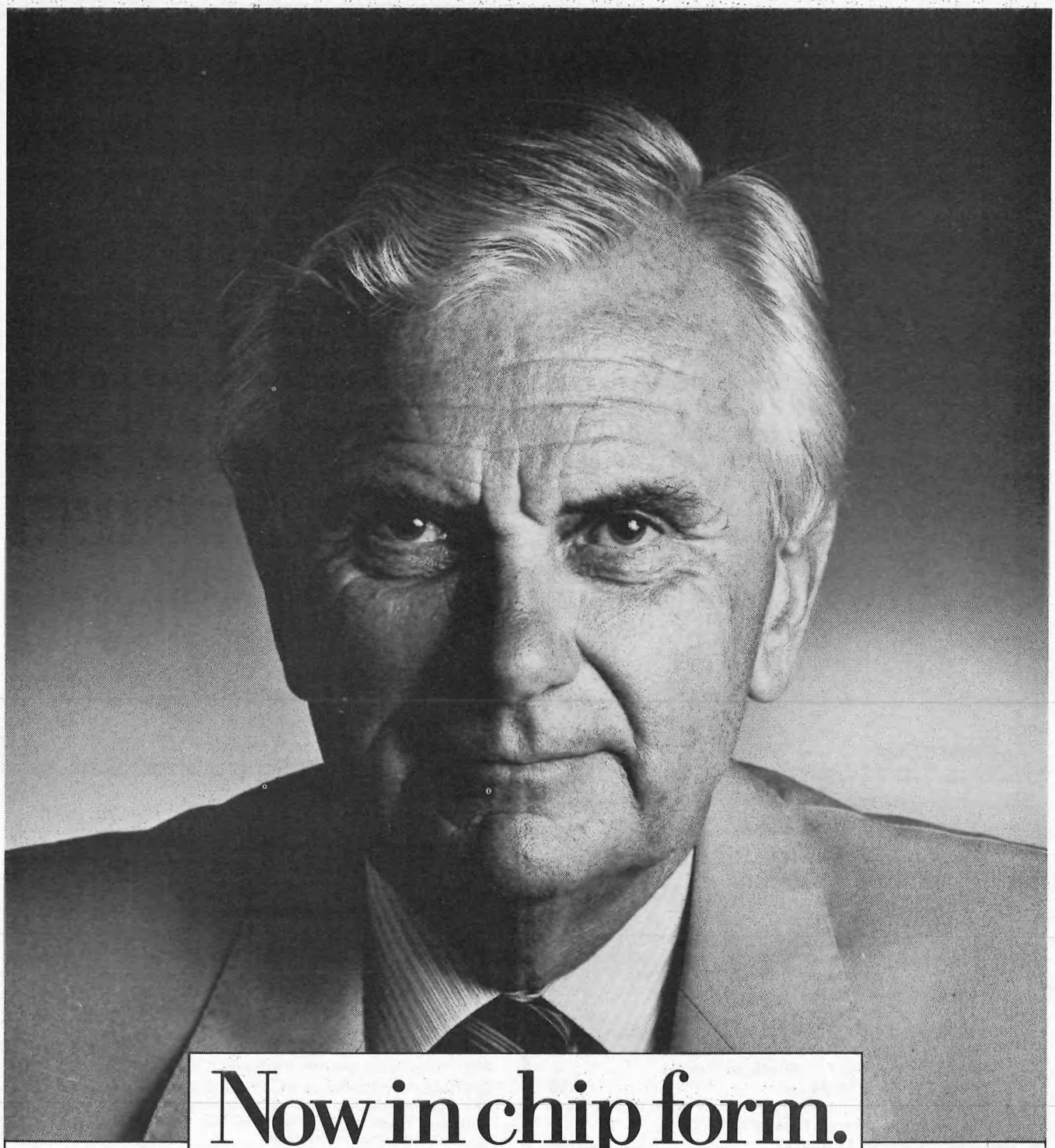

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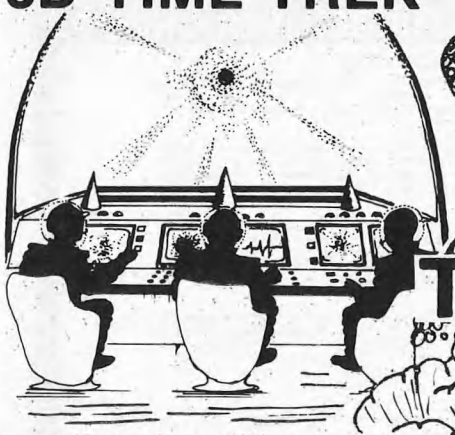

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March Issue: Program Features: Life (32K), Artillery Dual (16K/32K), Square Dance, Microsketch (16K) screen drawing program in only one line of code. 3D Rotation (will rotate any object). Printers for the BBC micro — Review of Epson, Seikosha, Tandy and Olivetti. What to do with the new Operating System Chip, Disc Formatter Program, and full Disc instruction set, Newcomers article on Text and Graphics Windows. **PLUS** How to get a new Operating System ROM and a special deal on Wordwise (members only).

April/ May Issue Special Anniversary Issue — Contains index to the whole of BEEBUG Volume 1. Music Composer — create complex 3 part harmonies with this synthesiser Program. **Colour bar chart generator** program. Beeb implementation of the **Connect-Four Game. Invasion** — a 16K. Plus **Review of Tape Recorders** for the Beeb; a Basic Program Editor, which lists variables and procedures, and executes find and Replace in a Basic Program; **Reviews of Acornsoft Games** and the **Torch Z80 Disc** Pack. Disc Menu Program. Newcomers introduction to Mode 7. How to save the unsaveable; and a routine to print Double Height characters in all modes.

June Issue: Program Features **'Return of the Diamond'** A 16K adventure game, **'hedgehog'** a well implemented 'Frogger' type game, and **Ellipto.** Create your own off the shelf sound effects with **Sound Wizard.** Plus articles on **using Files, Rotating and Expanding Characters, Using Printers,** and **How to multi-program the User Keys.** Reviews of **The Hobbit Floppy Tape System, Adventure Games, and a Comparative Review of Wordwise and View.** Plus **FX Call Update, Disc Program Auto-relocator, Wordwise Update,** and more **BBC Book Reviews.**

STOP PRESS
BEEBUG has negotiated a deal with ACORN over the new 1.2 OPERATING SYSTEM ROM. BEEBUG members are offered the ROM at around half-price. See BEEBUG Feb. Issue for details.

SOFTWAREE DETAILS

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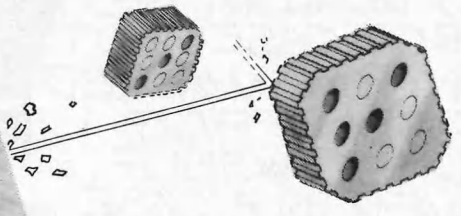

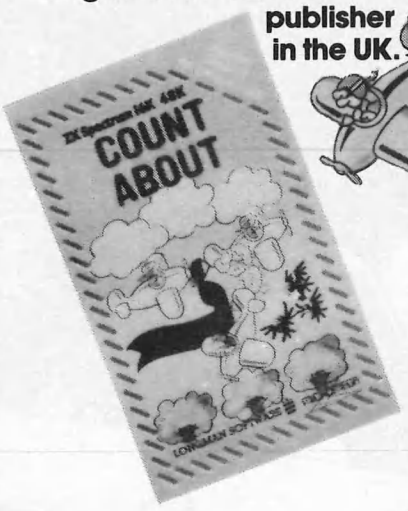

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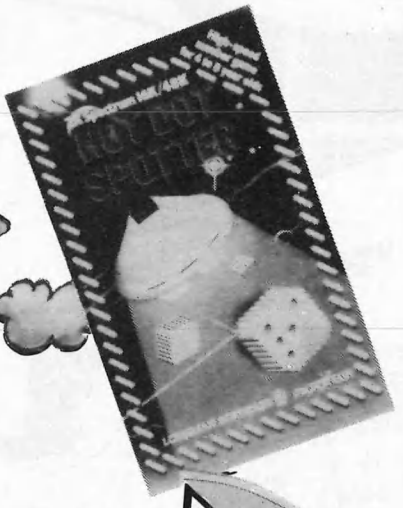

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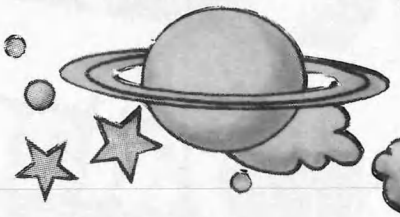

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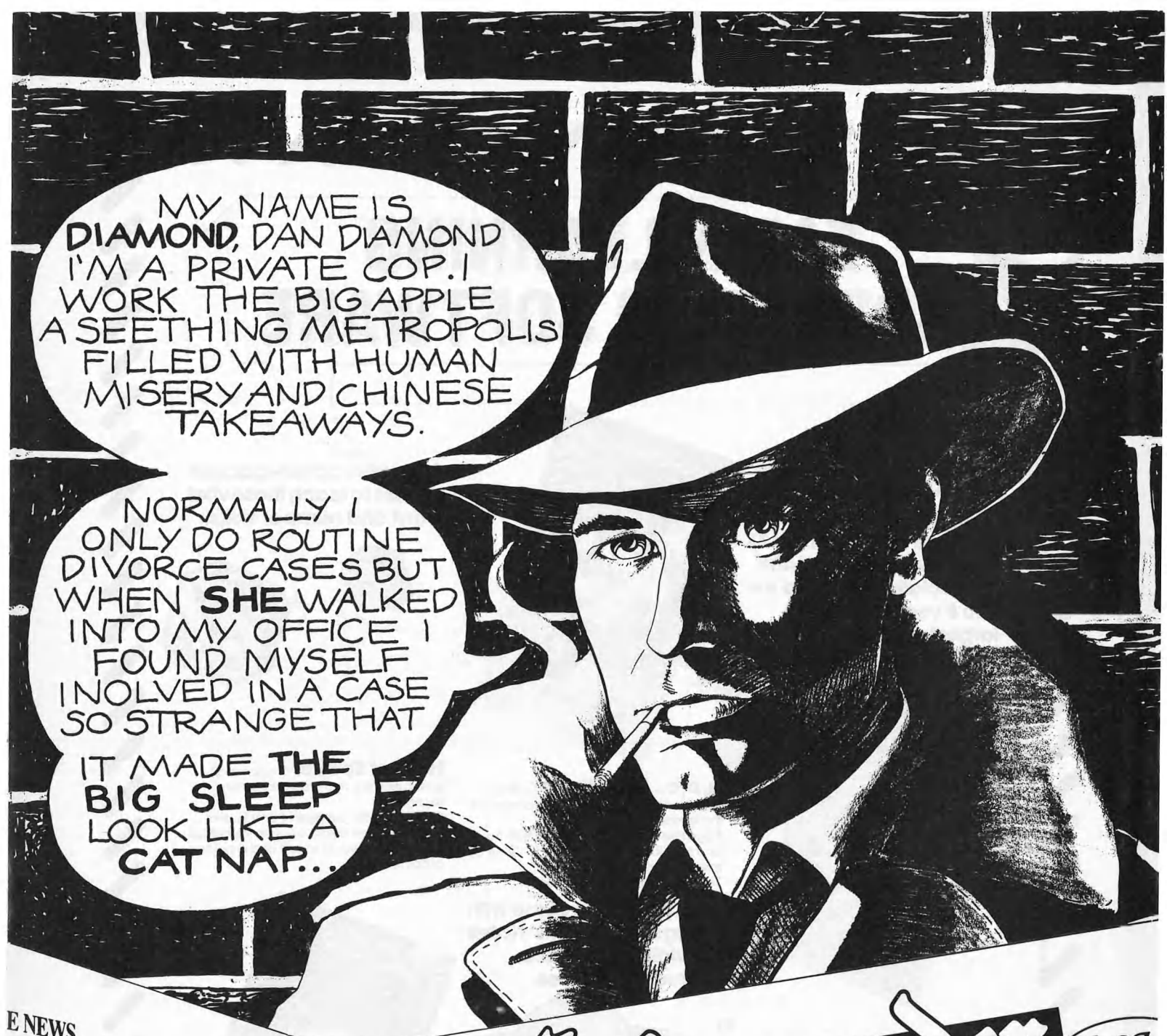

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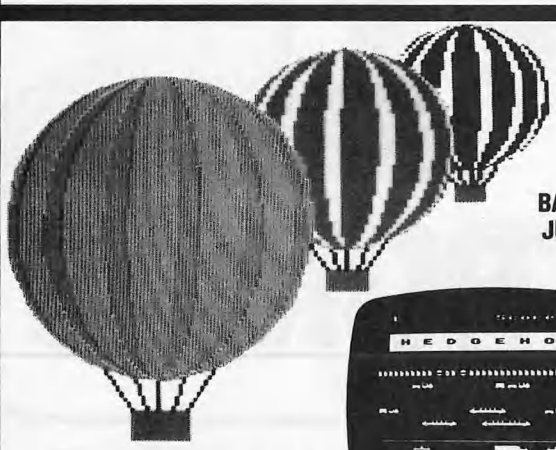

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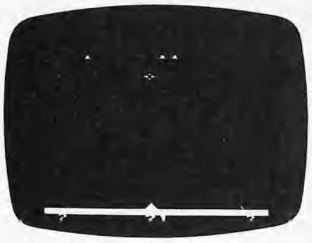

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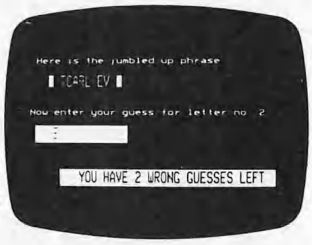

ANAGRAMS JULY 1983

Magazine programs now available on cassette to members at £3.50 inc: VAT & p&p—see April/May issue for details.

February Issue: *Program Features:* BEEBMAZE—Find your way through the random maze, guided by 3D views from inside the maze—an excellent game. FIVE-DICE—A Beeb implementation of YAHTZEE (R), a novel dice game. Also a listing of WINDY FIELD—a creation from Acornsoft, SPIROPLOT screen doodler, and a complete memory display program in a user key. Plus Machine Code Screen Dumps for the Epson and Seikosha Printers; articles on USING FILES, IDEAS ON ANIMATION (Including a Rotating Cube program), an Introduction to the Use of Procedures, a Survey of Books on the BBC Micro, and a Roundup of Disc System Hints. PLUS a variety of HINTS, TIPS AND INFO, including a single VDU command to perform a SIDEWAYS SCROLL.

March Issue: Program Features: Life (32K), Artillery Duel (16K/32K), Square Dance. 3D Rotation (will rotate any object). Printers for the BBC micro—Review of Epson, Seikosha, Tandy and Olivetti. What to do with the new Operating System, Disc Formatter Program, and full Disc instruction set, Newcomers article on Text and Graphics Windows. PLUS How to get a new Operating System ROM and a special deal on Wordwise (members only).

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July Issue: Games: Robot Attack (32K) and Anagrams, a 16K word game. Watching the Beeb at work — a simple program to show your micro at work. An introduction to discs —what are they and are they worth getting. Balloons — a coloured animation. Make your micro speak like Kenneth Kendal. Bad Program Lister — lists programs even when the computer pronounces them 'bad'. Reviews of Epson and Seikosha's new printers. Five books of programs reviewed, plus more software reviews. Using Files part 4. A full disc sector editor program — to read and retrieve lost disc files. And how to modify Acornsoft's Planetoid. Plus hosts of useful hints.

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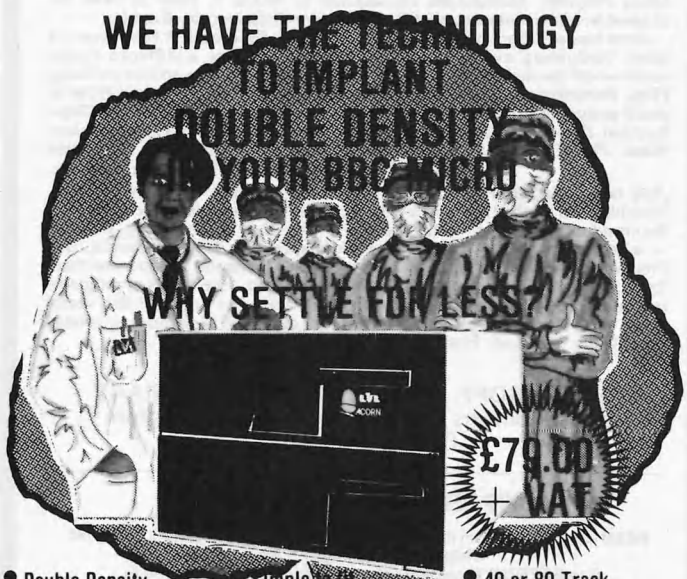

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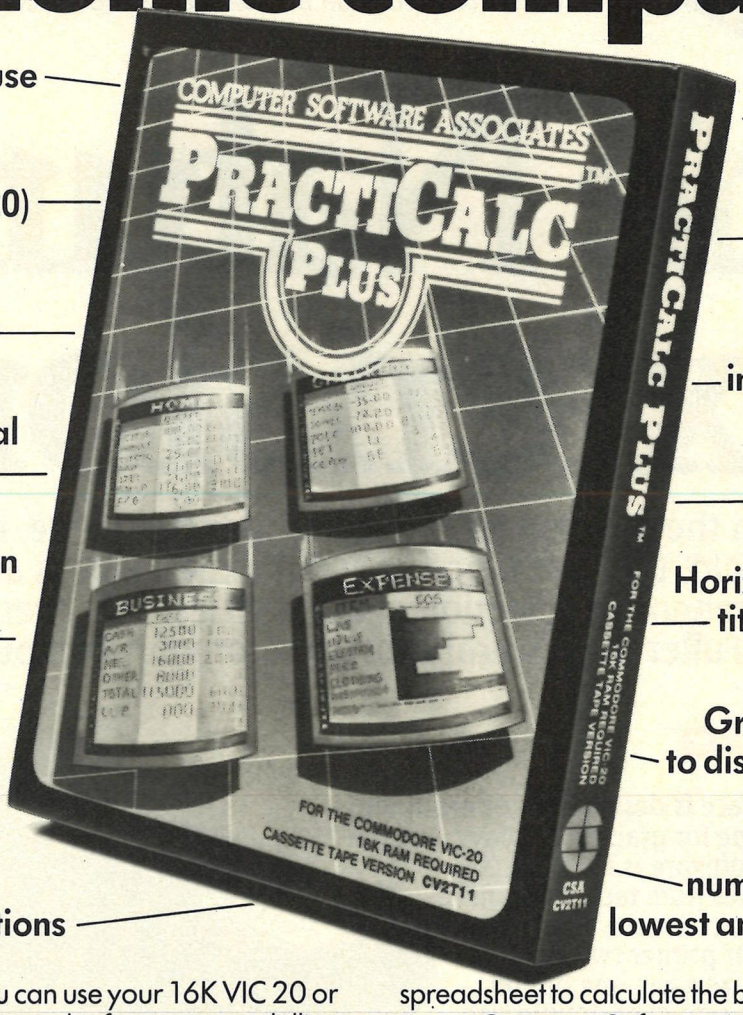

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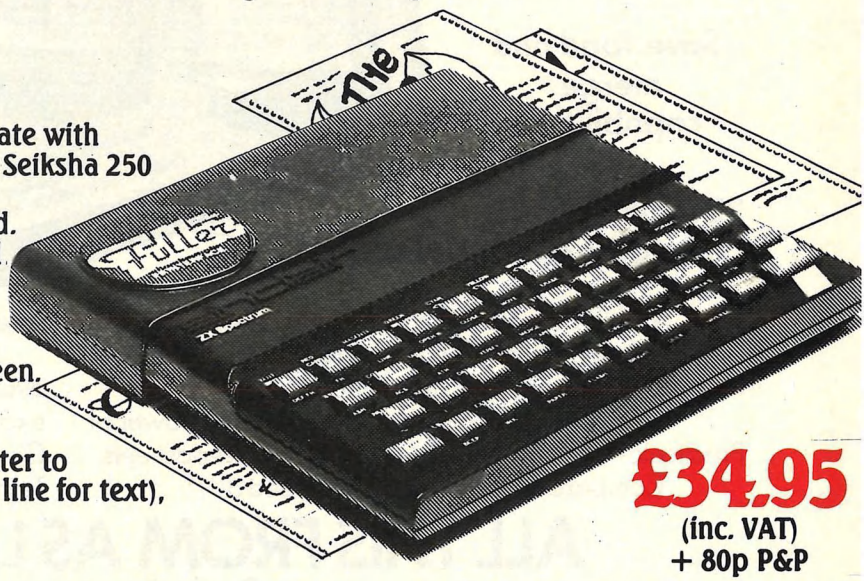

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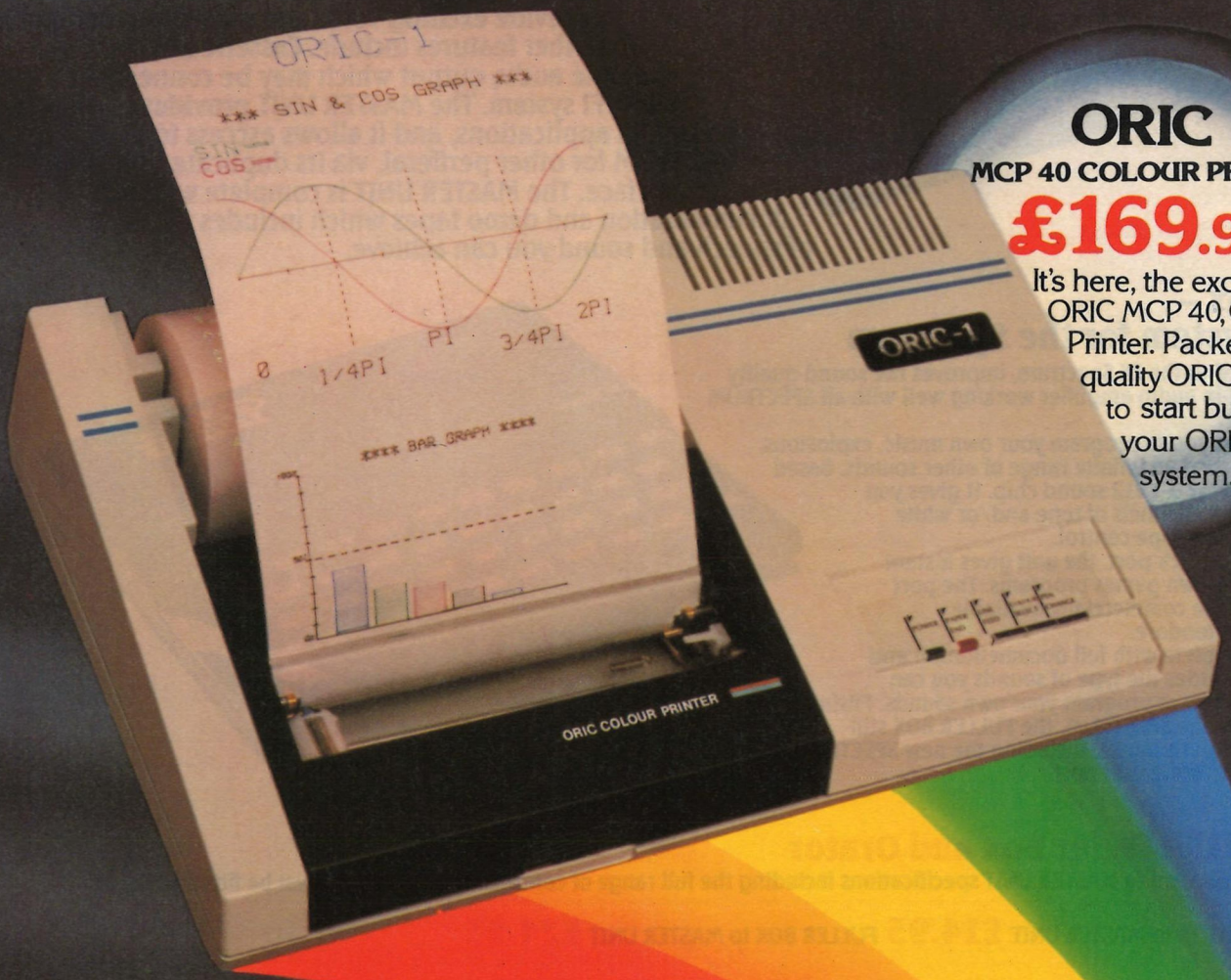

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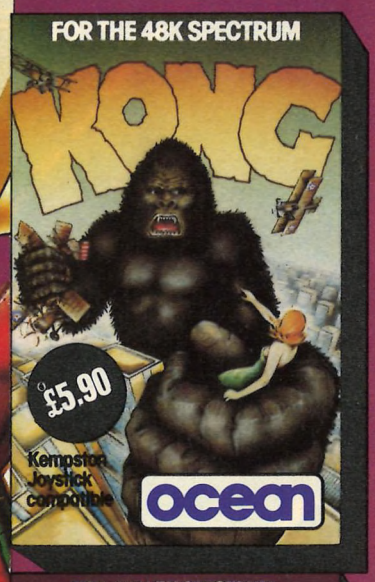

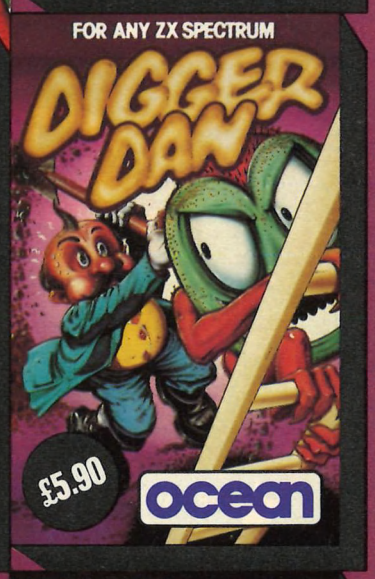

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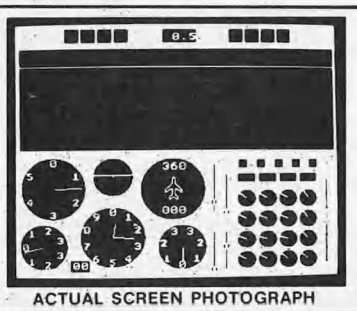

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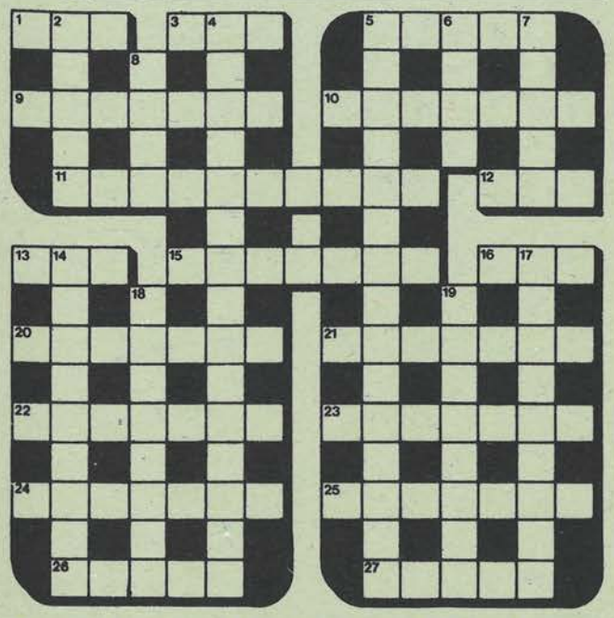

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22	Spare memory and release the sheep! (4, 3)
23	Breaks around about financiers (7)
24	Sags, consuming French wine deposits (7)
25	Point one follows: pelt with fire (7)
26	To understand Scottish sign (5)
27	Throw out ten pence found in eel (5)

DOWN

2	Madman with chip (5)
4	Reckoning on terminology for micros, minis and mainframes, for instance (9, 6)
5	Pale with fear, not out, I work on that extra bit (8, 7)
6	Roman therefore raised a monster (4)
7	Find error in a crack (5)
8	Jump-jet causes stray volt (1, 1, 1, 1)
14	Spoiled or not, save the meat course! (4, 5)
17	Digital Basic data that is dollarless (9)
18	Cartoon character of the times, basically (8)
19	Total that's turned in — it's a pun, OK? Certainly! (6, 2)

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RULES:

- The winner of the competition will be the person who enters a correct solution to the crossword and, in the view of the editor, completes the unfinished sentence in the most interesting way.
- The name of the winner will be printed in the November issue of *Your Computer.*
- All entries must arrive at the *Your Computer* offices by the last working day in September 1983.
- Each person may enter the competition only once.
- Entries to the competition cannot be acknowledged.
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